

February 5, 1992

# **SUGGESTED GUIDELINES**

**For**

## **ACCESSIBLE LAVATORIES IN TWIN AISLE AIRCRAFT**

Prepared By

**Ad Hoc Working Group on Design Guidelines**

February 5, 1992

**This document is the product of a special ad hoc working group formed by airframe manufacturers, airlines, and disability advocacy groups and representatives from federal agencies. It is maintained administratively, on behalf of the ad hoc working group participants, by the Air Transport Association of America as ATA Document 91-XX. Copies may be obtained by contacting ATA at the address listed below. Changes to the document are controlled and approved by the ad hoc working group. All of these groups are listed in Appendix A.**

**Copies of this document may be obtained by contacting the Air Transport Association of America, 1709 New York Avenue, Northwest, Washington, D.C. 20006, Attention: Specification Orders. Phone: (202) 626-4050, Fax: (202) 626-4149.**

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## INTRODUCTION

### I. THE PURPOSE OF THE SUGGESTED GUIDELINES

#### A. Why the Suggested Guidelines Were Created:

The United States Congress passed legislation known as the Air Carrier Access Act of 1986, P.L. 99-435, directing the Department of Transportation (DOT) to establish regulations assuring that air transportation is consistently accessible to passengers with disabilities. Subsequently, the Department of Transportation issued a broad series of regulations covering all aspects of accessibility. Included in these regulations is a requirement that newly manufactured aircraft with more than one aisle must have at least one accessible lavatory. Section 382.21 of the regulations, "Aircraft Accessibility," states,

Aircraft with more than one aisle in which lavatories are provided shall include at least one accessible lavatory. This lavatory shall permit a qualified handicapped individual to enter, maneuver within as necessary to use all lavatory facilities, and leave, by means of the aircraft's on-board wheelchair. The accessible lavatory shall afford privacy to passengers using the on-board wheelchair equivalent to that afforded ambulatory users. The lavatory shall provide door locks, accessible call buttons, grab bars, faucets, and other controls, and dispensers usable by qualified handicapped individuals including wheelchair users and persons with manual impairments.

Responsibility for monitoring compliance with these regulations rests with the Department of Transportation. Discussion among airlines and aircraft manufacturing companies made it apparent that enough questions of detail existed to show a need for more extensive compliance guidelines. The Air Transport Association and the Aerospace Industries Association formed an ad hoc working group with representatives from aircraft companies, airlines, disability advocacy groups, and concerned federal agencies to develop suggested, voluntary design guidelines for twin aisle aircraft lavatories sufficient to produce practical design details for affected aircraft. A listing of the members of the Ad Hoc Working Group is in Appendix A. The expectation is that these suggested guidelines will be accepted by the Department of Transportation as satisfying the noted regulations.

**B. Application of the Suggested Guidelines:**

These suggested guidelines will, when accepted by DOT, be made available on an unrestricted basis. Their use is completely voluntary. Individual carriers should determine on their own how to comply with 14 CFR Part 382. They may be used by airlines and their aircraft suppliers to develop specific designs which comply with or exceed the requirements of the regulations for their particular aircraft configurations. These guidelines do not specify a preferred accessible lavatory location in the airplane.

When these guidelines have been accepted by DOT, it is anticipated that each airline will proceed with detailed designs for its aircraft that reflect the criteria in these guidelines or that reflect other solutions providing equivalent facilitation.

These guidelines, developed in the context noted above, apply to newly manufactured aircraft with more than one aisle. It is anticipated that similar guidelines will be developed in the future to address other categories of aircraft, including specifically single-aisle aircraft.

**C. Scope and Organization of the Suggested Guidelines:**

There are two basic parts to the guidelines, Introduction, and Technical Provisions, (including Appendices). The regulatory material which these guidelines address (14 CFR § 382) is not reprinted herein.

**II. AD HOC COMMITTEE BACKGROUND**

**A. The Role of the Ad Hoc Working Group:** The Working Group was formed as a means of facilitating the integration of diverse interests held by disability advocacy groups, designers and aircraft operators. The Group was drawn deliberately to include individuals with specific experience in the design of such facilities in aircraft. Several individuals involved in the Working Group had previously been involved in the original DOT regulatory negotiations and discussions for Part 382. Representatives from DOT were involved in establishing the Working Group and participated in its work.

**B. How the Suggested Guidelines Were Developed:** Meetings were held in Washington, D.C. and at major airline hubs and manufacturers sites. These meetings included visits to operational aircraft to review actual designs and to explore a wide variety of possible design solutions. The framework for these Guidelines was modeled after the Guidelines for Aircraft Boarding Chairs developed by the Architectural and Transportation Barriers Compliance Board.

## TECHNICAL PROVISIONS

### I. DEFINITION OF TERMS

A. **ASSISTIVE EQUIPMENT** - Physical features that are used by passengers with disabilities, including visual and hearing impairments, e.g., hand bars, hand grips, platforms, signage and lighting to facilitate their use of the lavatory. Suggested guidelines for assistive equipment for persons with visual impairments are attached as Appendix C. Platforms are horizontal projections (frequently molded in) from a nearby wall that may be used for support in the manner of hand grips or hand rests.

B. **CALL BUTTON** - The control button in the lavatory used to illuminate the call light.

C. **CALL LIGHT** - A readily visible light outside the lavatory enclosure that can be illuminated by the use of a call button in the lavatory to advise the flight attendant to assist a passenger.

D. **LAVATORY** - A facility customarily used by passengers for their hygienic functions and appearance needs.

E. **LAVATORY ENCLOSURE** - An auxiliary area contiguous to a lavatory that can be separated from the passenger cabin so as to provide an expanded area for privacy and maneuverability for passengers with disabilities.

F. **SINK AND AMENITIES** - The sink (or wash basin) along with a drain control and a faucet assembly to provide hot or cold water for washing needs. Amenities typically include toilet paper, soap and paper towels, and a vanity mirror.

G. **TOILET FLUSH CONTROL** - A control that initiates the toilet flushing cycle.

H. **TRANSFER** - The physical movement of a passenger between a passenger seat, an on-board wheelchair, and/or a lavatory toilet seat. Some passengers can perform this transfer independently; others need physical assistance from another person. For passengers in the latter category, a variety of techniques may be used by a personal assistant to lift the passenger clear of one seat, move them until they are over the other seat, and then lower the passenger into a seated position. A passenger's angular change of position is expressed in terms of "degrees of transfer," e.g., in a 90 degree transfer, a passenger is pivoted through a 90 degree arc. In a zero degree or lateral transfer, a passenger transfers laterally from seat to seat. It must be noted that there is a wide variety of transfer techniques and toileting methods, each with its own spatial requirements. The space required for a 90

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degree transfer of a 97.5% male with a personal attendant who is also a 97.5% male should accommodate the needs of most other passengers with disabilities who use transfer techniques different from that described herein, whose method of using the toilet may not require transfer, or who use mobility aids.

I. **SIGNAGE** - An accessible lavatory provides signage that will afford use by those individuals with visual impairments or blindness.

J. **AUDIBLE WARNINGS** - Visual and audible warnings are needed so that an individual with visual or hearing disabilities may be instructed to leave the lavatory when necessary.

## II. HUMAN AND ENVIRONMENTAL FACTORS

A. Physical Characteristics of Users: Accessible lavatories, while modified for the needs of passengers with disabilities, can be used by all passengers. The underlying presumption is that the purpose of the design is to make the lavatory accessible to and usable by adult passengers who must be transported in an on-board wheelchair to reach the facility. The physical characteristics and functional needs associated with passengers with disabilities are described in Appendix B.

B. Aircraft Operating Environment: Consistent with 14 CFR § 382.39, a flight attendant will assist the passenger in the use of an on-board wheelchair, and operation of the lavatory/enclosure, but not passenger lifting or personal hygienic needs.

## III. GUIDELINES FOR DESIGN FEATURES

A. General Criteria: Accessible design features should not compromise the usefulness of such features by other passengers.

B. Lavatory:

1. The lavatory should be big enough to have the passenger, the on-board wheelchair, and a personal attendant entirely enclosed inside with the door closed. It should be possible for the passenger on the on-board wheelchair to pass through the lavatory door a sufficient distance into the lavatory to accomplish a transfer from the on-board wheelchair to the toilet seat. A 90 degree (or less) transfer would meet the needs of the greatest number of passengers requiring transfer. If these basic criteria are not met in the lavatory, see Part III.C (Lavatory Enclosure) below.

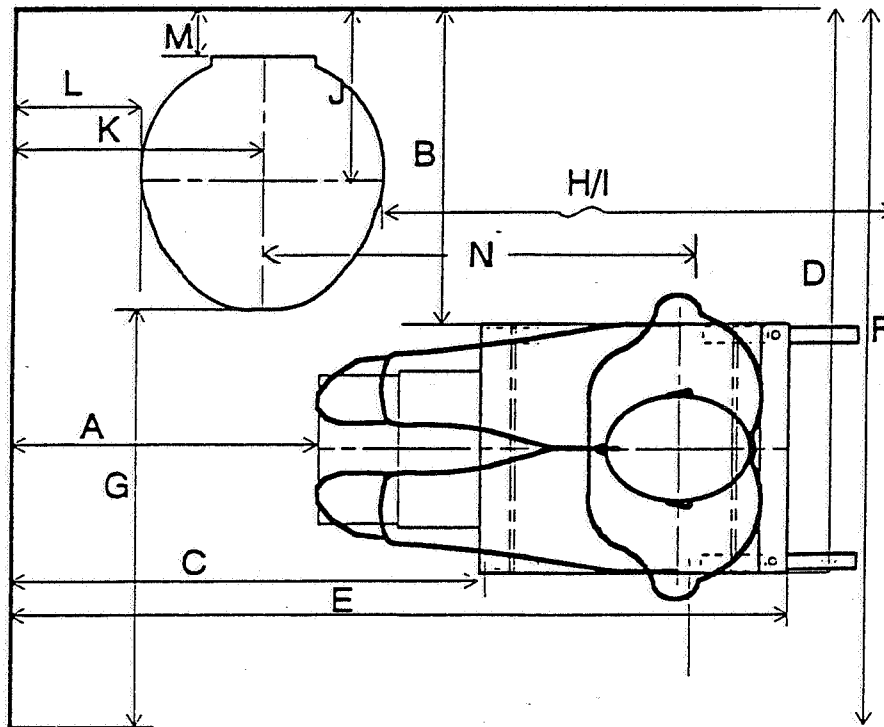
2. It shall also be possible to transfer back onto the on-board wheelchair.

3. Based on the spatial and functional characteristics specified in Appendix B, the dimensions below were determined to be necessary for the use of a lavatory by a 97.5% male passenger performing a 90 degree dependent transfer with the assistance of a 97.5% male personal attendant. The area contained within dimensions A and G in Figure 1 defines the operational space for the attendant in the process of performing the transfer. The arcs contained within dimensions B and N define the operational space required for clearance of the passenger's buttocks in the process of the transfer. Both of these spaces are to be open space adequate to permit transfer.

FIGURE I

DEPENDENT W/C MOBILITY TRANSFER/ 97% MALE ASSISTING

PRELIMINARY MEASUREMENTS  
1/18/91 - PVA STUDY  
C. GERALD WARREN & ASSOCIATES



- A. Wall to W/C footrest front = 19"
- B. W/C to wall = 20"
- C. Wall to W/C front wheel = 29"
- D. Wall to W/C side = 36 "
- E. Wall to W/C back = 48" (w/c handles folded in)
- F. Width required for transfer activities = 46"
- G. Front toilet to wall = 27"
- H. Maximum reach shoulder to fingertip = 30" 97% male
- I. Maximum reach shoulder to fingertip = 25" 2.5% female
- J. Center toilet back of wall = 11"
- K. Center toilet to side wall = 15 1/2"
- L. Edge of toilet to wall = 8"
- M. Toilet edge to back wall = 3"
- N. Distance to accommodate the maximum transfer radius for 97% male = 27"

ASSUMPTIONS:

- W/C PERSON - 19"W x 29"L (97% male dimensions)
- ABLE BODIED SQUATING - 19"W x 26" (97% male dimensions)
- PERSON ON TOILET - 19" x 29" (97% male)
- TOILET SEAT 15"W x 16"L

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Set forth below are minimum dimensions for a 90 degree transfer performed with the assistance of a personal attendant (Letters refer to dimensions depicted in Figure 1; see pages 17 - 19 in Appendix B):

- A. Wall to wheelchair footrest front - 19"
- B. Wall to wheelchair - 20"
- E. Wall to wheelchair back - 48"
- F. Width required for transfer activities - 46"
- G. Front of toilet to facing wall - 27"
- L. Toilet edge to side wall - 8"
- M. Toilet edge to back wall - 3"
- N. Distance to accommodate the maximum transfer radius for 97.5% male - 27"

**NOTE:** It is important to note that the handles of the on-board wheelchair used in Figure I fold in; the dimensions would likely be greater for a chair without this feature.

4. In addition to the dimensions from Figure 1, the following additional dimensions and criteria also apply:

- a. Door sill heights are not to constitute an obstruction to entry of an on-board wheelchair into the lavatory.
- b. Toe space 4 to 6 inches. Toe space is the distance from the base of the toilet shroud to the front of the toilet bowl.
- c. Unobstructed door opening width 20 inches;
- d. Toilet seat height 18 to 19 inches.

C. Enclosure Features:

- 1. Functional Needs: to provide sufficient space to contain, physically and visually,

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- a. A passenger seated on the toilet bowl with the on-board wheelchair within reach.
- b. A passenger seated on the on-board wheelchair within reaching distance of the toilet bowl or the sink.
- c. A passenger with a personal attendant and the accomplishment of toileting functions and/or a dependent transfer from the on-board wheelchair to and from the toilet bowl.

2. Design Needs:

- a. The purpose of the enclosure is to provide the functional equivalent of a closed lavatory. This would be facilitated by using a comparable latch locking mechanism and signage similar to that used on regular lavatory doors. This provides consistency for both the passenger and flight attendant. Lavatory doors and enclosures are to be capable of being locked and unlocked by the passenger from within the enclosure, and by the flight attendant from the outside.
- b. Lavatory enclosures, when in use, should maintain a level of privacy equivalent to regular lavatories with regard to visibility, security, noise and odor.
- c. In some aircraft configurations, it may be possible to use the existing lavatory door in conjunction with nearby walls or bulkheads to form the enclosure. Where this is done, it may be necessary to have additional lighting and a special switch to assure adequate lighting levels.

D. Assistive Equipment:

1. Handgrip Rails: To facilitate the passenger transfer, the following handgrip rails are to be provided:

- a. Basic Description: The rails are to be oriented consistent with those found in public facilities. One rail is to be mounted on the wall behind the toilet and one rail is to be mounted on the wall or cabinet opposite the door.



follows:

b. **Dimensions:** The rail dimensions and locations are to be as

- (1) Height above toilet 14-20 inches (without interfering with toilet lid and seat fold-up travel if possible).
- (2) Diameter of grip: 1 - 1.5 inches.
- (3) Length of grip: 12 inches where practicable.
- (4) Clearance between grip and wall: 1.25 - 1.5 inches.
- (5) Static load capacity: 250 pounds.

2. The following equipment may be installed to provide additional aid in transferring:

- a. **Platforms:** These may be mounted on either side of the toilet with a desirable height approximately equal to that of the toilet seat.
- b. **Additional handgrips:** These may be installed with a height of 32-38 inches from the floor.

E. Call Light:

1. This light is to be outside the enclosure when the enclosure is in use. Its function is to be consistent with the operation of such lights now typically mounted outside lavatories.
2. The call light button is to be a simple press-to-operate button with a smooth flat surface to push on. The button is to be appropriately marked and simple to operate. It should be within the reach of a 2.5% female seated either on the toilet seat or on an on-board wheelchair adjacent to the toilet bowl.

F. Toilet Flush Control: Since toilets typically operate off an electrical signal, the control really is a switch. Current designs that have the same physical appearance as household toilet flush controls are preferred. The control is to be within the reach of a 2.5% female seated on the on-board wheelchair adjacent to the toilet seat.

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G. Sink and Amenities: The typical elements of the system of sink and amenities include the sink, faucet, soap, toilet paper, vanity mirror, and towel dispenser. The sink and amenities should be configured so as to be accessible to a 2.5% female seated on the toilet seat or on the on-board wheelchair adjacent to the toilet seat. If the towel dispenser is not easily within reach, a flight attendant may place towels on the counter adjacent to the seat. Faucet and sink controls are to be of a type not requiring prehension or grasp to operate.

H. Signage: An accessible lavatory provides signage that will afford use by those individuals with visual impairments or blindness. Such signage will be tactile and high in contrast with its background. Additionally, any tactile text should be accompanied by its Braille translation.

Tactile signage will accompany those features or equipment that are necessary for an individual to properly and safely use the lavatory. Such features and equipment are as follows:

1. Lavatory I.D. on outside of door.
2. Lavatory door "VACANT/OCCUPIED" indication.
3. Lavatory door locking mechanism.
4. Toilet flush lever or switch.
5. Flight attendant call button.
6. Water faucet controls (indication of hot and cold water on lever/switch).
7. Soap, towels, and trash receptacle locations.

NOTE: For those lavatories equipped with bi-fold doors, the instructional placards for PUSH and PULL to operate will be tactile.

Accessible signage dimensions and locations approximate the following: (dimensions were incorporated from ANSI Standard A117.1)

#### Text Characters

1. Height - 1 to 2 inches.
2. Font - uppercase bold Sans Serif or uppercase bold Helvetica.

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3. Texture - eggshell (11-19 degree gloss).
4. Contrast - 70% with background (light letters/dark background).
5. Tactility - raised 1/32 of an inch.
6. Location - adjacent to described feature or equipment.

Braille (to accompany all raised letters)

1. Type - grade II Braille.
2. Dot Height - 1/32 of an inch (minimum).
3. Dot Position - 1/2 of an inch below corresponding raised letter.
4. Dot Spacing - conform with the Uniform Braille Authority.

I. Audible Warnings - In order that an individual with visual or hearing disabilities may be instructed to leave the lavatory when necessary, visual and audible alarms are needed. These warnings are to be activated whenever the "FASTEN SEAT BELT" sign is illuminated on the aircraft.

The following suggestions for warnings are identical or similar to systems presently used in today's aircraft and airlines.

**Audible**

1. Warning Signal - bell or chime followed by announcement to "fasten seat belts/return to seat" made by the flight crew
2. Sound Level - 15 decibels above equivalent prevailing sound level (maximum sound level - 120 decibels).

NOTE: Present public address system in lavatory is sufficient.

**Visual**

1. Warning Symbol - pictograph as described in TARC Document Number 82-89 (see figure 2), instructing passengers to return to their seats.
2. Warning Lighting - pictograph should be of the illuminating type with either positive or negative form (arrow should always be RED).



**Return to Seat**

To be used in lighted signage exclusively. The figure and seat may appear in either the positive form (dark gray) or negative form (lighted-white). The arrow should always be red.

FIGURE 2

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#### **IV. EQUIVALENT FACILITATION**

Departures from particular provisions of these guidelines are permitted where the alternate means provide substantially equivalent or greater access to, and usability of, lavatories or lavatory enclosures.

Carriers can achieve the purposes of these Guidelines by demonstrating that an alternative method will result in equivalent facilitation. Such alternative means should permit individuals with disabilities to approach, enter, and use a lavatory as easily, conveniently, and independently as the means described above in Section III would permit.

Any alternative method should be validated by a demonstration that satisfies the Department of Transportation Regulations. The methodology used in the demonstration should be developed in consultation with individuals with training in research techniques who are familiar with the physical requirements of persons with disabilities, including methods of transfer, toileting, and use of mobility aids.

APPENDIX A

MEMBERS OF THE AD HOC WORKING GROUP

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William Chen	Pan American World Airways
Fred Cowell	Paralyzed Veterans of America
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Sharon McDermott	Paralyzed Veterans of America
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Ira Laster, Jr.	Department of Transportation
Donald R. Trilling	Department of Transportation

**APPENDIX A**

**MEMBERS OF THE AD HOC WORKING GROUP -  
CONTINUED**

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Carlos Dos Pasos	USAir
C. Gerald Warren	C. Gerald Warren & Associates
Nancy Gemmell	WDTA
Gerald Lee	WDTA
Richard Sias	WDTA
Hale Zukas	World Institute on Disability

**FINAL DRAFT**

**July 5, 1991**  
**(Revising May 16 draft)**

**Appendix B**

**FUNCTIONAL CATEGORIES  
OF PERSONS WITH DISABILITIES  
AND  
OPERATIONAL DIMENSIONS  
FOR DESIGNING  
ACCESSIBLE AIRCRAFT LABORATORIES**

**PREPARED FOR:  
PARALYZED VETERANS OF AMERICA  
NATIONAL EASTER SEAL SOCIETY  
NATIONAL MULTIPLE SCLEROSIS SOCIETY  
UNITED CEREBRAL PALSY ASSOCIATIONS, INC.**

**FEBRUARY 1991**

**REPORT PREPARED BY:  
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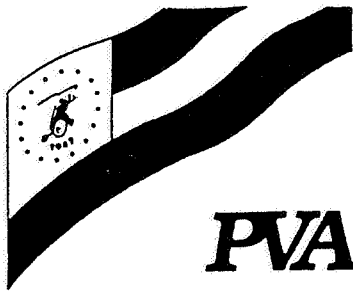
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**FINAL DRAFT**

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PARALYZED VETERANS  
OF AMERICA  
Chartered by the Congress  
of the United States

NOTICE TO USERS

This study ("Functional Categories of Persons with Disabilities and Operational Dimensions for Designing Accessible Aircraft Lavatories") was commissioned by the Paralyzed Veterans of America (PVA), National Easter Seal Society, National Multiple Sclerosis Society, and United Cerebral Palsy Association, Inc. in order to assist PVA and other disability rights organizations for the purpose of responding to a Notice of Proposed Rulemaking issued by the Department of Transportation to implement the Air Carrier Access Act (49 U.S.C. § 1374(c)). The study and data contained therein, unless otherwise specified, remain the property of the Paralyzed Veterans of America and other named organizations.

While this study was prepared for a limited purpose, PVA believes that it is the first detailed analysis of its type. PVA has had requests for copies of the study from the travel industry and others interested in commissioning designs or constructing lavatories that comply with various laws requiring various levels of access for persons with disabilities. It is the policy of PVA to make this study available at no cost to all interested parties. However, written authorization for the use, reproduction or distribution of the study must be obtained in advance from PVA.

Users of the study are cautioned to note the limited context within which this study was conducted. Enclosures constructed with the minimum space requirements listed in the study are not guaranteed to meet the requirements of law. PVA recommends empirical study and testing for functionality and legal compliance with complete mock ups of any proposed enclosures before embarking on construction.

For further information, contact Maureen McCloskey, Associate Advocacy Director.

  
John C. Bollinger  
Acting National Advocacy Director

ANY REPRODUCTION OF THIS STUDY MUST CONTAIN THIS NOTICE TO USERS

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## INTRODUCTION

This study conducted by C. Gerald Warren and Associates investigated the functional and spatial requirements travelers with disabilities would have in their use of lavatories on commercial aircraft. The information requested was originally intended for use in responding to the notice of proposed rulemaking, indicated in the Federal Register, Volume 55, No. 44, Tuesday, March 6, 1990. This study addresses the concern expressed in Paragraph B, regarding accessible lavatories on narrow-bodied aircraft with 100-199 seats.

The study was influenced by the project's sponsors and the investigator being involved in three meetings of the "Lavatory Accessibility Design Subgroup" associated with the Air Transport Association. As a result of the involvement the scope of work was modified slightly to place greater emphasis on developing operational dimensions that can be used as guidelines in design of aircraft lavatories in general.

The purpose of the study was to address the functional needs of the traveler with a disability. The primary concern was to meet their need to access the lavatory with dignity and privacy.

This study was conducted in two phases; In Phase 1, categories of mobility impairment were defined and the function and physiology as it relates to lavatory use was described for each category. In Phase II of the study the maximum spatial requirements were established for the activities of persons performing independent and dependent transfers using an in-flight wheelchair (Biskay Industries). The operational measurements for the transfer activities were determined using both anthropometric and empirical data.

It is important to note that the investigators believe the operational measurements established within this scope of work can be significantly refined through further empirical study using a more complete lavatory mock-up in which the dimensional parameters can be varied and evaluated.

## PHASE I

### Description

In Phase I of the study, the categories of persons with mobility impairments were developed.

- A. Limited Ambulation - Unaided
  - Group 1 - Unaided Walker with normal toileting
  - Group 2 - Unaided Walker with altered toileting
- B. Limited Ambulation with Aids
  - Group 1 - Assisted Walker with normal toileting
  - Group 2 - Assisted Walker with altered toileting
  - Group 3 - Marginal Walker with medical complications
- C. Wheeled Mobility
  - Group 1 - Independent transfer with normal toileting
  - Group 2 - Partially independent transfer with altered toileting
  - Group 3 - Dependent transfer with normal toileting
  - Group 4 - Dependent transfer with altered toileting
  - Group 5 - Spinal Cord Injury with altered toileting

The categories were described in terms of possible diagnosis falling in each subgroup and the physiologic considerations for toileting needs of each group. The physiologic considerations are described by either normal volitional control or altered management of the bladder and bowel by using method, technique or specialized equipment. This information is summarized in the following tables. A thorough narrative describing each category can be found in Appendix A.

The physical spatial requirements for each category was compared to a typical 90 and 180 degree lavatory. (These typical lavatory dimensions were made available by United Airlines). The comparisons illustrated, for each of the categories, include the mobility aid and use of the in-flight aircraft wheelchair in the typical lavatory and can be found in Appendix B.

## SUMMARY - PHASE I

### FUNCTIONAL CATEGORIES OF PERSONS WITH DISABILITIES

#### A. LIMITED AMBULATION- UNAIDED

##### GENERAL DESCRIPTION

Limited in walking  
Does not use aid or special equipment  
1-hand support in environment  
Portable oxygen

##### FUNCTIONAL LIMITATIONS

Walks short distances 20-30 feet  
Unsteady, slow gait  
Fatigues easily  
Shortness of breath  
Risk of fall  
Vertigo  
May be unable to lift or carry  
May be unable to come to stand without some assistance  
Can manage one step  
Limited stationary standing  
Weakness in muscles - legs, trunk, arms, hands  
Limited dexterity  
Joint range restricted  
Pain in sitting, standing or movement  
Flaccid, spastic muscles with uncontrolled movement  
Limited stature  
May use portable oxygen  
Decreased sensation in parts of body

#### GROUP 1 - Unaided walker with normal toileting

DIAGNOSIS	FUNCTIONAL USE OF LAVATORY	PHYSIOLOGY
Cerebral Palsy Epilepsy Muscular Dystrophy Amputation Poliomyelitis Arthritis Chronic Back problems Cardiac Cancer Adult Respiratory Distress Syndrome Little people  Orthopedic	Walk to lavatory Can do 90' or 180' transfer - standing to pivot Can take 1-2 steps forward Need grab bars Portable oxygen May need help with clothing May need help with wiping May need lift to toilet Needs space for casts & appliances	Volitional Control of bladder and bowel on timed basis Minimal incontinence

**GROUP 2 - Unaided walker with altered toileting**

<b>DIAGNOSIS</b>	<b>FUNCTIONAL USE OF LAVATORY</b>	<b>PHYSIOLOGY</b>
Frail and Elderly Multiple sclerosis Obesity Stroke, CVA Renal Failure Head Injury Spinal Cord Injury (Cauda Equina/Incomplete injury)	Walk to lavatory Can do 90° or 180° transfer - standing to pivot Can take 1-2 steps Need grab bars May need help with clothing May need help with wiping	Volitional Control of bladder and bowel on timed basis Frequency & urgency Minimal incontinence May use pads or or leg bags

**B. LIMITED AMBULATION WITH AIDS**

**DESCRIPTION**

Walks short distances - 10-20 feet  
Must use aid for walking.

**DESCRIPTION OF EQUIPMENT**

Canes - single, 3 or 4 footed  
Walker - pick up or rolling  
Crutches - forearm or underarm  
Prosthetic devices - artificial limbs  
Orthoses  
Portable Oxygen  
1 person with hand hold on belt

**FUNCTIONAL LIMITATIONS**

Unsteady, slow gait  
Fatigues easily  
Shortness of breath/may use oxygen  
Risk of falling  
Unable to lift or carry - limited dexterity  
May be unable to sit down or stand up without assistance  
Cannot manage stairs  
Cannot stationary stand  
Weakness in muscles - legs, trunk, arms, hands  
Limited joint range or restricted movement  
Pain on movement  
Flaccid, spastic or uncontrolled movement  
Decreased sensation in parts of body

**GROUP 1 - Assisted Walker with Normal Toileting**

**DIAGNOSIS**

Cerebral Palsy  
Spastic Diplegia  
Athetoid  
Hemiplegic  
Amputation  
Poliomyelitis  
Muscular Dystrophy  
Arthritis  
Orthopedic  
Cardiac  
Epileptic  
Congenital defect

**FUNCTIONAL USE  
OF LAVATORY**

May need extra space  
Needs leg room if  
joint restricted  
Can take 1 step  
Help with leg over  
threshold  
Clothing difficulty  
if wearing appliances

**PHYSIOLOGY**

Volitional bladder  
and bowel control  
usually timed control  
May use leg bag  
May use pads



**GROUP 2 - Assisted Walker with Altered Toileting**

**DIAGNOSIS**

Multiple Sclerosis  
Elderly  
Obesity  
Stroke, CVA  
Head Injury  
Neuromuscular Diseases  
Developmentally Disabled

**FUNCTIONAL USE  
OF LAVATORY**

Needs help to come  
to stand  
Needs help in 90' or  
180' turn transfer  
Can take 1 step and  
pivot  
May need help with  
clothing  
May need raised seat  
May need grab bars -  
both sides  
May use portable urinal  
May need help wiping

**PHYSIOLOGY**

Urgency & frequency  
Partial muscle control  
of sphincters  
Daily bowel program  
unregulated to time  
Bladder emptying  
unregulated to time  
Incontinence when  
stressed  
May use pads or leg  
bag appliances

**GROUP 3 - Marginal Walker- Medical Complications**

**DIAGNOSIS**

Cancer  
AIDS  
Spinal Cord Injury  
incomplete paraplegia

**FUNCTIONAL USE  
OF LAVATORY**

See Group #1 and 2

**PHYSIOLOGY**

Partial volitional  
control  
Needs odor containment  
& material containment  
Urgency, frequency  
May have ileostomy  
or colostomy bags  
Vomiting/nausea  
Bruises/Bleeds easily

## C. WHEELED MOBILITY

### DESCRIPTION

Must use in-flight wheelchair to move about

### DESCRIPTION OF EQUIPMENT

Manual folding/non-folding wheelchair  
Electric non-folding wheelchair  
3-Wheeled electric scooter  
Stretcher - 4-wheeled supine positioning  
Cart - 4-wheeled - reclined sitting  
Respirator, portable oxygen

### FUNCTIONAL LIMITATIONS

Uses upper extremities, hands for balancing and mobility  
Unable to stand, bear weight on legs, pivot, take steps  
Unable to come to standing position without physical assistance  
Unable to manage thresholds (1" or above)  
Needs physical assistance in transfers from seat to in-flight wheelchair or to toilet  
Altered sensation or proprioception  
May have flaccid, rigid, or uncontrolled movement  
Balance deficits - needs trunk support  
May need head support or restraint  
Poor body temperature regulation  
Poor endurance for activity  
Minimal hand/finger dexterity  
Joint range/flexibility restrictions  
Needs support to maintain sitting posture  
May be ventilator dependant

### GROUP 1 - Independent Transfers - Normal Toileting \*

DIAGNOSIS	FUNCTIONAL USE OF LAVATORY	PHYSIOLOGY
Cerebral Palsy Muscular Dystrophy Poliomyelitis Orthopedic Arthritis Amputation Brain Injury *Does not include Spinal Cord Paraplegia	90° or lateral transfer possible Can do transfer, if wheelchair is next to toilet Needs space for reaching to lock the wheelchair brakes Needs grab bars Can use sliding board for transfer Lifting, leg positioning Help with clothing Help with wiping	Volitional control of bladder & bowel Daily bowel elimination 4-6 hr. bladder elimination Has sphincter control

**GROUP 2 - Partially Independent Transfers-Altered Toileting \***

<b>DIAGNOSIS</b>	<b>FUNCTIONAL USE OF LAVATORY</b>	<b>PHYSIOLOGY</b>
Multiple sclerosis Neuromuscular Disease Stroke/Cerebral Vascular Accident Head Injury Developmental Disability  * Does not include Spinal Cord Injury, Quadriplegia	90° or lateral transfer possible with minimal to moderate assistance May need help with clothing, hygiene, and appliances May use communication device May use portable urinal to empty leg bag	Frequency of urgency Neurogenic bowel with little control Neurogenic bladder with little control Incontinent of urine May use pads, indwelling or external catheter, leg bag, colostomy bag

**GROUP 3 - Dependent Transfers - Normal Toileting - 1 person needed for transfers \***

<b>DIAGNOSIS</b>	<b>FUNCTIONAL USE OF LAVATORY</b>	<b>PHYSIOLOGY</b>
Cerebral Palsy Muscular Dystrophy Poliomyelitis Orthopedic Arthritis Amputation  * Does not include Spinal Cord Injury	Travels with aide trained in care Difficult access to lavatory- need room for 1 person assistance Needs full assist with clothing, hygiene, and appliances May need full body, head support	Volitional control of bladder and bowel Daily bowel elimination 4-6 hour bladder elimination Has sphincter control

**GROUP 4 - Dependent Transfers - Altered Toileting - 1 person needed for transfers**

<b>DIAGNOSIS</b>	<b>FUNCTIONAL USE OF LAVATORY</b>	<b>PHYSIOLOGY</b>
Severely Disabled with Multiple Medical Problems Ventilator Dependent Quadriplegic	Always travel with aide trained in care Needs 1 person for transfers Full assist with clothing Full assist with hygiene Full body, head support Full assist with leg bag emptying	Neurogenic bowel Neurogenic bladder Feeding tube Suctioning care Emergency medical for ventilation Autonomic dysreflexia May need to travel on stretcher Respiratory function with ventilator

**GROUP 5 - Spinal Cord Injury**

**DIAGNOSIS**

Paraplegia

**FUNCTIONAL USE  
OF LAVATORY**

Grab Bars  
Independent in 90'  
and lateral transfer  
May need to reach under  
toilet seat to buttocks  
May need help with  
clothing and hygiene  
Assist in body support  
Empty leg bag in the  
lavatory

**PHYSIOLOGY**

Neurogenic bowels -  
managed with a method  
to prevent accidents  
24-48 bowel program  
Needs suppository  
& digital  
Neurogenic bladder  
Managed with a method  
of timed intermittent  
catheterization  
Leg bag equipment  
Minimal accidents  
Indwelling or  
external catheter

Quadriplegia

**DIAGNOSIS**

**FUNCTIONAL USE  
OF LAVATORY**

May need physical  
assist of 1  
person to transfer  
May need emergency care  
for autonomic  
dysreflexia for  
immediate bowel  
or bladder emptying

**PHYSIOLOGY**

Neurogenic bowels -  
managed with a method  
to prevent accidents  
24-48 bowel program  
needs suppository  
& digital  
Neurogenic bladder  
Managed with a method  
of timed intermittent  
catheterization  
Leg bag equipment  
Minimal accidents  
Ileostomy or colostomy  
bag needing emptying  
May also use  
indwelling or  
external catheter  
May need help to empty  
leg bag

## PHASE II

### Description

The operational dimensions defined in this portion of the study were established considering the characteristics of persons in the categories of:

Limited Ambulation - Unaided

Limited Ambulation with Aids

Wheeled Mobility

The objective was to determine the minimum space required to allow persons in all categories to access the toilet in an aircraft lavatory. We believe that if the spatial requirements of those persons in the category of wheeled mobility were met appropriately that the other two categories of ambulation unaided and with aids would be adequately accommodated.

It was determined that this study would address the spatial requirements of 90 degree transfers (i.e. the long axis of the toilet and wheelchair at 90 degrees) and a lateral transfer where the long axis of each are parallel. The 90 degree transfer requires rotation of the body through a 90 degree arc. The lateral transfer is accomplished by translating the body sideways.

### General Methodology

A very simple mock lavatory was constructed consisting of one side wall, a back wall and a toilet. A 15" x 16" area for the toilet was determined from the available specifications on the current aircraft lavatory toilets. The back wall to the back of the toilet space was determined to be 3" to allow for hip angle variance in sitting/back support and buttock space. The toilet seat height was 18 1/2" from the floor. The in-flight wheelchair foam seat cushion compression of 1/2" brings the toilet seat and wheelchair seat at equal height for safe, optimal transfer.

The mock toilet was positioned to allow 8" of hand/shoulder space between the toilet seat edge and the side wall. This will allow hand hold/grab bar positioning and use, shoulder girth variance when the hips are rocked sideways during the transfer, and clothing manipulation.

In Phase II of the study, the spatial requirements for persons using wheeled mobility were determined and illustrated with operational measurements for the following transfer activities.

1. Independent 90 Degree Transfer
2. Dependent 90 Degree Transfer / 97.5% male assisting
3. Independent Lateral Transfer
4. Dependent Lateral Transfer / 97.5% male assisting
5. Dependent 90 Degree Transfer / 97.5% male assisting - Arc for Buttocks Clearance

The illustrations have been produced using an AutoCad compatible system. A complete description of each operational measurement accompanies the diagrams.

The spatial requirements were determined using anthropometric data (range in sizes of people) and by using empirical data obtained by performing transfer activities with disabled persons of appropriate size.

The anthropometric data was taken from Human Scale.(1) In the analysis, the dimensions of a 97.5% male (i.e. only 2.5% of the male population is bigger) were used in determining the minimum spatial requirements. Using these measurements, the space required for entering, turning, management of clothing and sitting or squatting at the lavatory toilet was determined. It is presumed that if 97.5% males are able to use the space then all other smaller sized persons will be accommodated. The exception being those persons of exceptionally small stature or persons with inability to sit with hips at a 90 degree angle. These people would likely use adaptive equipment or require assistance from an aide within the lavatory enclosure.

## DESCRIPTION OF FIGURES

Within the wheeled mobility category - Independent 90 Degree Transfer (Figure 1), the space dimensions have been determined by the 97.5% male seated on the in-flight wheelchair and transferring to the toilet. Space has been defined for a 90 degree transfer where the in-flight wheelchair seat edge is positioned flush to the toilet front edge and front right wheel of the wheelchair is aligned with the front edge of the toilet. To position the in-flight wheelchair, the person's feet are removed forward off the foot rest, the foot rest flipped upward and the feet positioned to pivot at a center point directly in front of the toilet.

In performing the Dependent 90 Degree Transfer (Figure 2), space is defined for a 97.5% male who would do a front facing pivot transfer. The person assisting enters the lavatory first and positions the wheelchair and feet for the transfer. Sufficient space is allocated for the able-bodied person to assume a biomechanically correct squatting position for lifting. The in-flight wheelchair is positioned further away from the toilet by 6". The space defined for the aide is 19" x 26" in front of the toilet with the in-flight wheelchair positioned at 90 degrees.

In performing the Lateral Independent Transfer (Figure 3), space is defined for a 97.5% male entering the lavatory through the back wall of the toilet, and positioning the wheelchair parallel to the toilet. The transfer is performed with the feet off the wheelchair footrest and at a 45 degree angle to the front edge of the toilet. The push up transfer motion is sideways to the toilet.

The Dependent Lateral Transfer, (Figure 4), is basically performed in the same sequence as defined in the dependent 90 degree transfer. The person assisting will position the wheelchair directly parallel to the toilet, remove the feet and perform a pivot transfer. The space defined for the aide is directly to the front and facing the toilet.

The Dependent 90 degree Transfer/Arc for Buttocks Clearance (Figure 5), were requested in order to establish the minimum distance between the door and the

opposing wall. The data was determined empirically by performing various dependent transfer techniques with 97.5% male disabled persons.

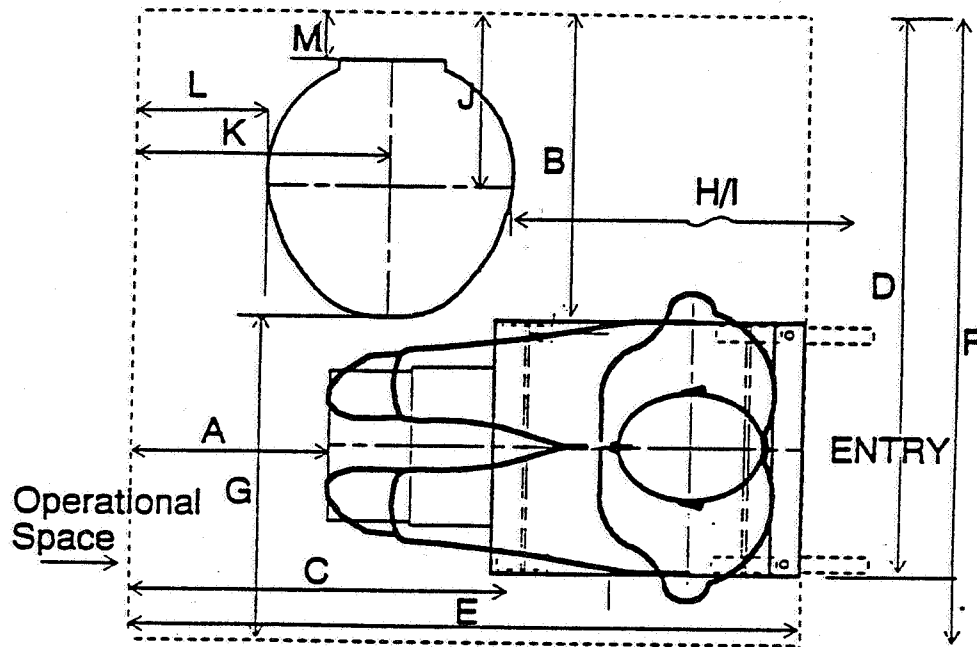
In the original scope of work the operational measurements defined by this study were to be compared with the existing dimensions of lavatories in a limited number of narrow bodied aircraft. Data on existing lavatory dimensions was difficult to obtain because the airframe manufacturers could not release information proprietary to their customers. In addition, the variability in lavatory configurations made it difficult for air carriers to respond with appropriate data. Appendix C contains the method used to gather dimensions of existing lavatories and a table showing the only pertinent data collected.

In conclusion, the study has defined the operational measurements for 90 degree and lateral transfers by independent and dependent wheelchair users. It is believed that these spatial dimensions will accommodate the limited ambulatory population. The challenge ahead remains in how these operational measurements can be used in the design of aircraft lavatories.



# INDEPENDENT 90° TRANSFER OPERATIONAL MEASUREMENTS

2.14.91 - PVA STUDY  
C. GERALD WARREN & ASSOCIATES



- A. Wall to W/C footrest front = 12"
- B. Wall to W/C = 19"
- C. Wall to W/C front wheel = 23"
- D. Wall to W/C side = 35"
- E. Wall to W/C back = 42" (w/c handles folded in)
- F. Width required for transfer activities = 39 1/2"
- G. Toilet front to wall opposite = 20 1/2"
- H. Max. reach shoulder to fingertip = 30" 97.5% male
- I. Max. reach shoulder to fingertip = 24.7" 2.5% female
- J. Toilet center from wall behind = 11"
- K. Toilet center from side wall = 15 1/2"
- L. Toilet edge to side wall = 8"
- M. Toilet edge to back wall = 3"

## ASSUMPTIONS:

PERSON IN W/C - 19"W x 29"L (97.5% male dimensions)

ABLE BODIED SQUATTING - 19"W x 26" (97.5% male dimensions)

TOILET SEAT 15"W x 16"L

### Independent 90 degree Wheelchair Transfer - Figure 1

The operational measurements are defined using a 97.5% male positioned on an in-flight aircraft wheelchair. In the independent 90 degree transfer, the wheelchair enters through a side entry. The wheelchair is locked in this transfer position. A forward leaning, push-up transfer method is used with the feet pivoting in the space to the front of the toilet and wheelchair. The following narrative describes the dimensions listed A through M.

A. Wall to wheelchair footrest front = 12"

The 12" allows for a 97.5% male foot to be taken off the footrest and placed in front of the wheelchair so the footrest can be folded up in preparation for the transfer.

B. Wall to wheelchair = 19"

The dimension from the back wall to the side of the wheelchair when positioned next to the toilet. This is the transfer ready position dimension.

C. Wall to wheelchair front wheel = 23"

Establishes the wheelchair front wheel in relationship to the facing wall when the footrest is in the fold back position.

D. Wall to side of wheelchair = 35"

Back wall to outer side of the wheelchair as it may enter through the doorway.

E. Wall to wheelchair back = 42" (wheelchair handles folded in)

The overall dimension to accommodate the full length of the wheelchair and foot space in front of the wheelchair for the transfer. This represents the space to enclose the wheelchair within the lavatory during the transfer.

**F. Width required for transfer activities = 39 1/2"**

The overall space needed to transfer from the wheelchair to the toilet using a forward leaning motion and push up with the arms. The 4 1/2" of space added to measurement "D" represents space needed for headroom as the chest is brought down to the knees and the trunk assumes a horizontal position.

**G. Front toilet to wall opposite = 20 1/2"**

The space from the toilet edge to the front facing wall allows headroom for the forward leaning described in "F".

**H. Maximum reach shoulder to fingertip = 30" (97.5% male)**

The maximum reach to the doorway and amenities within the lavatory.

**I. Maximum reach shoulder to fingertip = 24.7" (2.5% female)**

The maximum reach to the doorway and amenities within the lavatory.

**J. Toilet Center from wall behind = 11"**

The center point of the toilet to the back wall.

**K. Toilet Center to side wall = 15 1/2"**

The space allocated for the width of a 97.5% male hand (4.5") and space for shoulder width in a side leaning motion.

**L. Toilet Edge to side wall = 8"**

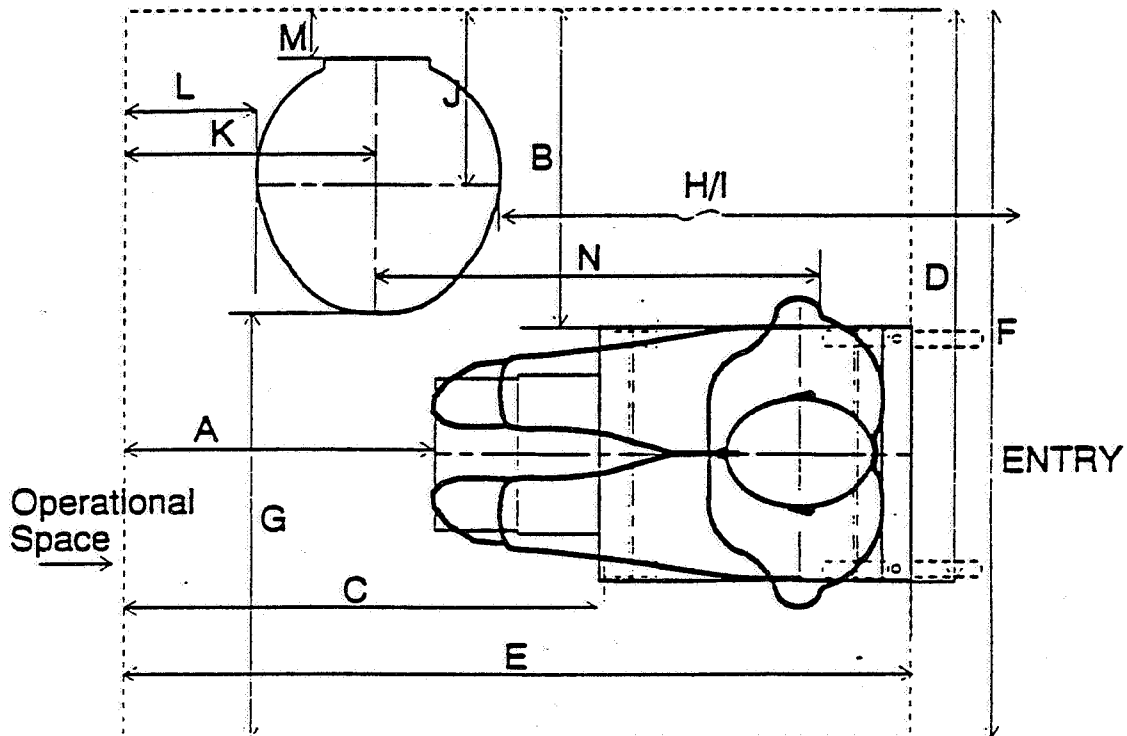
The 8" hand space is the width of the hand and sufficient space for side leaning from the toilet side edge to be able to perform the toileting and dressing activities.

**M. Toilet to back wall = 3"**

The space between the back of the toilet to the back wall.

# DEPENDENT 90° TRANSFER/97.5% MALE ASSISTING OPERATIONAL MEASUREMENTS

2.14.91 - PVA STUDY  
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- A. Wall to W/C footrest front = 19"
- B. Wall to W/C = 20"
- C. Wall to W/C front wheel = 29"
- D. Wall to W/C side = 36 "
- E. Wall to W/C back = 48" (w/c handles folded in)
- F. Width required for transfer activities = 46"
- G. Toilet front to wall opposite = 27"
- H. Maximum reach shoulder to fingertip = 30" 97.5% male
- I. Maximum reach shoulder to fingertip = 24.7" 2.5% female
- J. Toilet center from wall behind = 11"
- K. Toilet center from side wall = 15 1/2"
- L. Toilet edge to side wall = 8"
- M. Toilet edge to back wall = 3"
- N. Transfer radius for 97.5% male = 27"

## ASSUMPTIONS:

PERSON IN W/C - 19"W x 29"L (97.5% male dimensions)

ABLE BODIED SQUATTING - 19"W x 26" (97.5% male dimensions)

TOILET SEAT 15"W x 16"L

**Dependent 90 degree Transfer, 97.5% Male Assisting - Figure 2**

The operational measurements are defined using a 97.5% male positioned on an in-flight aircraft wheelchair. The dependent 90 degree transfer is performed by the person assisting standing in the space in front of the toilet and the wheelchair footrest. The space in front of the toilet is necessary for the person assisting and the transferee to accomplish the pivot transfer. The following describes the dimensions listed A through N.

**A. Wall to wheelchair footrest front = 19"**

This clear space allows a 97.5% male attendant to squat down, lift the feet off and fold the footrest, perform dressing and hygiene activities and to prepare to perform the transfer.

**B. Wall to wheelchair = 20"**

Distance from the wheelchair in a transfer ready position to the wall behind the toilet.

**C. Wall to wheelchair front wheel = 29"**

This position accommodates the 97.5% male attendant squatting in a transfer ready position.

**D. Wall to wheelchair side = 36"**

Back wall to outside of wheelchair as it may enter through the doorway.

**E. Wall to Wheelchair back = 48" (Wheelchair handles folded in)**

The overall dimension to accommodate the full length of the wheelchair and space for the 97.5% male attendant to do the transfer.

F. Width required for transfer activities = 46"

The maximum dimension needed to perform a pivot transfer from the wheelchair with a 97.5% male attendant squatting while transferring the person on the wheelchair.

G. Front toilet to wall opposite = 27"

The space needed for the 97.5% male in a squatting position to assist with toileting and dressing activities.

H. Maximum reach shoulder to fingertip 97.5% male = 30"

I. Maximum reach shoulder to fingertip 2.5% female = 24.7"

The maximum reach to the doorway and amenities within the lavatory.

J. Toilet Center from wall behind = 11"

The center point of the toilet to the back wall.

K. Toilet Center from side wall = 15 1/2"

The space allocated for the width of a 97.5% male hand (4.5") and space for shoulder width in a side leaning motion.

L. Toilet Edge to side wall = 8"

The 8" space is the width of the hand and sufficient space for side leaning from the toilet side edge to be able to perform the toileting and dressing activities.

M. Toilet Edge to back wall = 3"

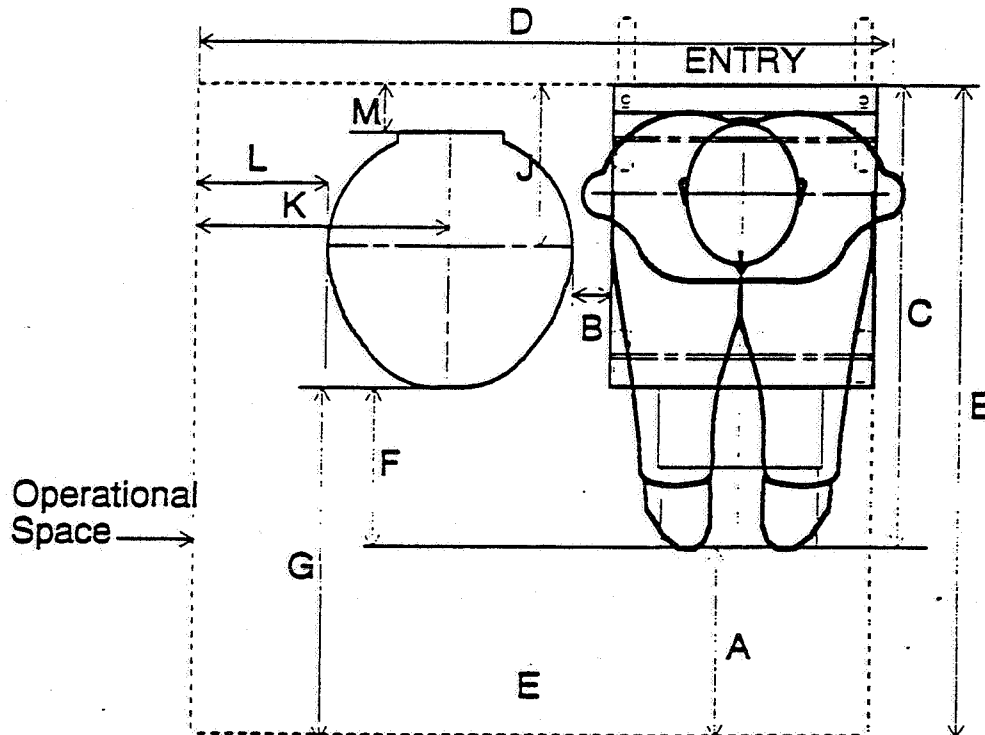
The space between the back of the toilet to the back wall.

N. Transfer radius for 97.5% male = 27"

Maximum distance from center line of toilet to the possible location of a wall. Please refer to Figure 5 for further explanation of this dimension.

# INDEPENDENT LATERAL TRANSFER OPERATIONAL MEASUREMENTS

2.14.91 - PVA STUDY  
C. GERALD WARREN & ASSOCIATES



- A. Wall to W/C footrest front = 12"
- B. Toilet edge to W/C = 2"
- C. Wall to W/C footrest front = 29"
- D. Wall length behind toilet = 42 "
- E. Wall length at W/C side = 41" (w/c handles folded in)
- F. Toilet front to W/C footrest end = 10"
- G. Toilet front to wall opposite = 22"
- H. not applicable
- I. not applicable
- J. Toilet center from entry wall = 11"
- K. Toilet center from side wall = 15 1/2"
- L. Toilet edge to side wall = 8"
- M. Toilet edge to entry wall = 3"

## ASSUMPTIONS:

PERSON IN W/C - 19"W x 29"L (97.5% male dimensions)

ABLE BODIED SQUATTING - 19"W x 26" (97.5% male dimensions)

TOILET SEAT 15"W x 16"L

### Independent Lateral Transfer - Figure 3

The operational measurements are defined using a 97.5% male on the in-flight wheelchair. To facilitate a lateral transfer, the entry into the lavatory must be accommodated on the wall to the backside of the toilet. The wheelchair will be positioned parallel to the toilet with the wheelchair handles folded inward. The vertical support of the toilet is assumed to be flush and not extending beyond the toilet seat dimensions of 15" W x 16" L. The following describes the dimensions listed A through M.

A. Wall to wheelchair footrest front = 12"

The 12" is for a 97.5% male foot to be taken off the footrest and placed in front so the footrest can be folded up in preparation for the transfer.

B. Toilet edge to wheelchair = 2"

The width of space required for the 97.5% male on the wheelchair to be positioned next to the toilet.

C. Wall to wheelchair footrest front = 29"

This is the length of the wheelchair with handles folded in.

D. Wall length behind toilet = 42"

The overall length to accommodate the wheelchair entry.

E. Wall length at wheelchair side = 41" (wheelchair handles folded in)

Accommodates the wheelchair inside space with door closed.

F. Toilet Front to wheelchair footrest end = 10"

Toilet front edge to the end of the wheelchair footrest.



**G. Toilet front to wall opposite = 22"**

Toilet front edge to wall including the space needed for head clearance during transfer from the toilet back.

H. N/A

I. N/A

**J. Toilet Center from entry wall = 11"**

The center point of the toilet to the back wall.

**K. Toilet Center from side wall = 15 1/2"**

The space allocated for the width of a 97.5% male hand (4.5") and space for shoulder width in a side leaning motion.

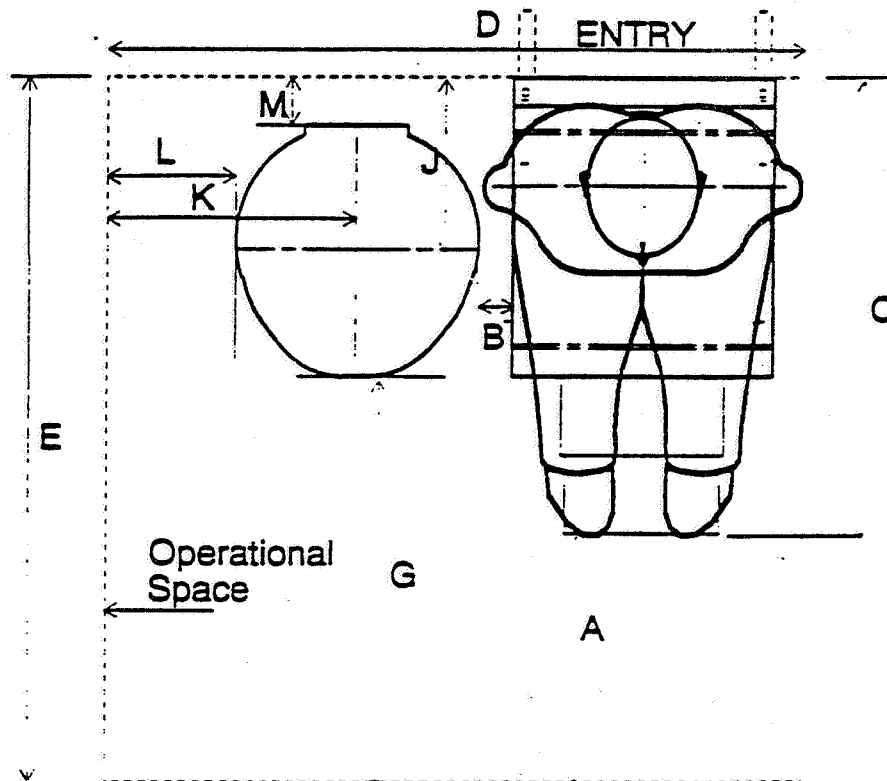
**L. Toilet Center to side wall = 8"**

The 8" space is for hand placement during the transfer and room for side leaning to be able to perform the toileting and dressing activities.

**M. Toilet Edge to entry wall = 3"**

# DEPENDENT LATERAL TRANSFER/97.5% MALE ASSISTING OPERATIONAL MEASUREMENTS

2.14.91 - PVA STUDY  
C. GERALD WARREN & ASSOCIATES



- A. Wall to W/C footrest front = 16"
- B. Toilet edge to W/C = 2"
- C. Wall to W/C front wheel = 29"
- D. Wall to W/C side = 42"
- E. Wall to W/C back = 45" (w/c handles folded in)
- F. n/a
- G. Toilet front to wall opposite = 26"
- H. n/a
- I. n/a
- J. Toilet center from wall behind = 11"
- K. Toilet center from side wall = 15 1/2"
- L. Toilet edge to side wall = 8"
- M. Toilet edge to back wall = 3"

## ASSUMPTIONS:

PERSON IN W/C - 19"W x 29"L (97.5% male dimensions)

ABLE BODIED SQUATTING - 19"W x 26" (97.5% male dimensions)

TOILET SEAT 15"W x 16"L

**Dependent Lateral Transfer - 97.5% Male Assisting - Figure 4**

The operational measurements are defined using a 97.5% size male on the in-flight wheelchair and the space to include a 97.5% male assisting to do a pivot transfer from a squatting position. To facilitate the lateral transfer, the person assisting will enter the lavatory and bring the wheelchair into position parallel to the toilet. The space described could include the wheelchair within the lavatory.

The following describes each dimension listed A through M.

**A. Wall to wheelchair footrest front = 16"**

Requires 16" for a 97.5% male foot to be taken off the footrest in preparation for the transfer and for a 97.5% male to squat down.

**B. Toilet Edge to wheelchair = 2"**

The width of space required for the 97.5% male on the wheelchair to be positioned next to the toilet.

**C. Wall to wheelchair front wheel = 29"**

This is basically the length of the wheelchair.

**D. Wall to side of wheelchair = 42"**

Distance from the wall to accommodate the width of a 97.5% male on the wheelchair.

**E. Wall to wheelchair back = 45" (wheelchair handles folded in)**

Accommodates the wheelchair parallel to the toilet, and includes the body space of a 97.5% male on the wheelchair and 26" from the toilet front edge. The person assisting will take the feet off the footrest and pivot the hips on the wheelchair before the transfer. The space required includes the 97.5% male assisting in the squatting position during the transfer.

F. N/A

G. Clear front to opposing wall = 26"

The clear space from the front of the toilet to the facing wall. The clear space allows a 97.5% male to assume the squatting position for the pivot transfer.

H. N/A

I. N/A

J. Toilet Center from wall behind = 11"

The center point of the toilet to the back wall allowing 3" of space for buttock size variance from toilet seat to wall.

K. Toilet Center from side wall = 15 1/2"

The space allocated for the width of a 97.5% male hand (4.5") and space for shoulder width in a side leaning motion.

L. Toilet Center to side wall = 8"

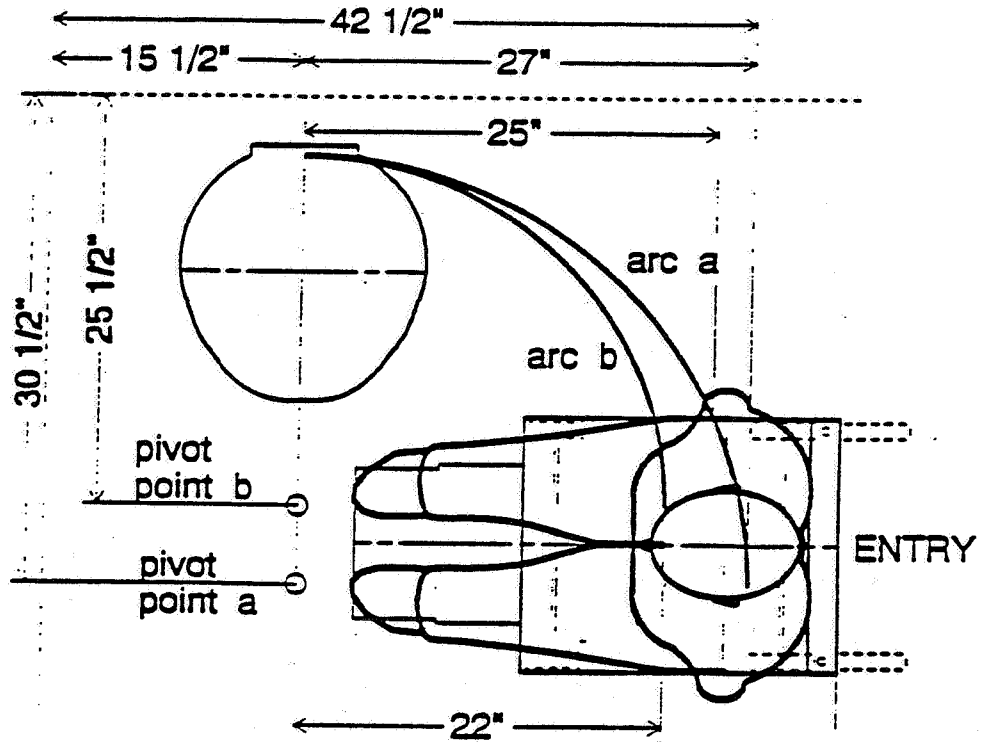
The 8" space for hand placement for transfer and side leaning space to be able to perform the toileting and dressing activities.

M. Toilet Edge to back wall = 3"

The space between the back of the toilet to the back wall allowing 3" of space for buttocks size variance.

# DEPENDENT 90° TRANSFER/97.5% MALE ASSISTING ARC FOR BUTTOCK CLEARANCE

2.14.91 - PVA STUDY  
C. GERALD WARREN & ASSOCIATES



NOTE: REFER TO DIAGRAM OF DEPENDENT  
90° TRANSFER FOR OPERATIONAL  
MEASUREMENTS

**Dependent 90 degree transfer, 97.5% male assisting**  
**Arc for Buttock Clearance - Figure 5**

The operational measurements are defined using a 97.5% male on the in-flight wheelchair. The wheelchair position is described in the diagram "Dependent 90 degree transfer" and remains the same.

To determine the arc of the buttocks clearance, a range of pivot points was established. The two pivot points (a and b) become the center of the arc with the radius of the curvature defined by 27" and 22" respectively, incorporating arc a and b.

The following describes the dimensions:

1. The toilet center to side wall and wall behind are the same as described in J through M on the Dependent 90 degree transfer diagram.
2. The in-flight wheelchair position remains as described in A through D on the Dependent 90 degree transfer diagram.
3. Pivot point "a" is 30 1/2" from the wall behind the toilet and centered to the toilet. This is the pivot point of the maximum arc for a 97.5% male foot/knee position with the radius of the curvature being 27". The thighs of the person being transferred are relatively horizontal.
4. Pivot point "b" is 25 1/2" from the wall behind the toilet and centered to the toilet. This is the pivot point of the minimum arc when the person being transferred had their legs more extended and were therefore more upright.
5. In preparation for the transfer, the 97.5% male is brought forward 4" from the seat back of the in-flight wheelchair by the assisting person (this is 6" from back of the wheelchair). The measurement of 25" from the center of the toilet to the side of the wheelchair represents the point at which the buttock passes the side of

the wheelchair. Arc "a" describes the necessary clearance made with the thighs relatively horizontal. Arc "b" describes the clearance necessary for a transfer made with the transferee being held more upright.

6. The operational measurement of 42 1/2" is the overall space required from the wall facing to a proposed entry wall. This represents the minimal overall space to accommodate the 97.5% male assisting, the width required for transfer activities, and the buttocks clearance through an entry reference.

7. The dimension of 27" from the center of the toilet outward is the minimal measurement for clearance of the buttocks and is 5 1/2" shorter than the overall dimension of "F" in the Dependent 90 degree transfer.

**APPENDIX**

**A. Narrative Description of Categories**

**B. Comparable Lavatory Designs**

**C. Lavatory Configuration Data**

**D. References and Acknowledgements**



## APPENDIX A

### NARRATIVE DESCRIPTION

#### A. LIMITED AMBULATION - UNAIDED

##### GENERAL DESCRIPTION

In this category, the person may have a significant limitation in walking but does not use any aids or special equipment to walk or stand. They may use an occasional hand hold for support and need help in balancing. They may have difficulty walking any distance, getting up from seated positions, lifting their feet, etc. due to weakness or poor control of their legs and feet. They may experience dizziness or vertigo, and generally have limited endurance. People in this category may use portable oxygen during ambulation or any strenuous movements. The portable oxygen may be carried by a traveler with a disability in an over the shoulder carrying case or on a small wheeled cart. In-flight portable oxygen will have to be prior arranged by the airline. This traveler may require another person for assistance.

This category may include people who have a newly acquired temporary disability from a traumatic injury, disease, or surgery from which they may be recuperating. The person with a disability in this group may often travel alone. They may easily adapt to the environment, but may require specific accessibility configurations to function independently. The disabling condition may be evident by observation of slowness, limited balance, difficulty in breathing, or an unusual gait pattern. The limitation may not be readily apparent such as in a person with a cardiac condition.

##### FUNCTIONAL LIMITATIONS

This population will likely be able to walk short distances ranging up to 20 to 30 feet of length at one time. Frequent rest periods may be needed due to weakness in legs, shortness of breath on exertion and physical difficulty in walking. A slow,

laborious method of walking associated with loss of balance and vertigo may create potential risks of falling. Safety should be a primary consideration in this population, who will have difficulty in negotiating ramped, uneven surfaces, carpeting, and managing more than one, seven inch step or thresholds more than one inch in height.

These persons may need physical assistance to come to a standing position from sitting especially if the height of the seat is less than 18 inches from the floor. Movement of the legs may be restricted due to limited joint flexibility, pain or casts and braces. Persons with such joint movement limitations will need extra leg room to assume a sitting position and may have to sit partially reclined for comfort. Static standing for more than a few minutes will be intolerable. If a person has decreased or lack of sensation in parts of the body, poor circulation, or pain, they will need to shift their weight or move about often to be comfortable and to protect their skin from pressure sore development. Some persons will use a special cushion under the buttocks to help in weight distribution.

These people will exhibit a wide range of muscle strength and coordination. There may be generalized body weakness which could influence hand dexterity and use of arms for support or lifting and carrying items. They may have lost strength and use of one side of the body. They may be limited in all extremities by jerky, uncontrolled movements; thus managing seatbelts, switches and handles will be difficult.

The stature of the individual may influence their functional skills to manage in the environment. Very large people, extremely tall or obese people will have difficulty being comfortable and fitting into the generally restricted spaces on the aircraft.

Persons of short stature, under 3-4 feet in height, may not be able to see signs and symbols beyond their range of sight and will have difficulty accessing seat heights higher than 13 inches.

This population will generally be able to walk on board the aircraft and down the aisle to their seat and to the lavatory. As they walk to the lavatory, they may use the seat backs for hand holds and support along the way.

## DIAGNOSIS and GROUPING FOR FUNCTION

### GROUP 1- Unaided Walker with Normal Toileting

Cerebral Palsy  
Epilepsy  
Muscular Dystrophy  
Amputation  
Poliomyelitis  
Arthritis  
Orthopedic/Fractures  
Cardiac  
Chronic back Problems  
Cancer  
Little People  
Adult Respiratory Distress Syndrome

### Access to Lavatory / Functional Use

This group will be able to walk short distances to the lavatory and enter the space and do either a 90 degree or 180 degree turn. If space is insufficient to turn, the person may back into the lavatory. Standing to pivot on one or both feet is feasible if the turn around space allows room to accommodate an extended leg in sitting positions. Total weight bearing on one leg may be restricted. Vertically oriented grab bars should be used next to the toilet on both sides to aid in sitting and standing.

Assistance from another person may be needed to help the person with a disability to wipe after toileting and to manage clothing on and off while the person uses one or two hands for support in maintaining a standing position. In the population of Little People, their needs are particularly oriented to limits in reaching fixtures and seat height of the toilet. Actual physical assistance may be needed to lift a person onto/off of the toilet. Incontinence is minimal and use of pads or

collection devices should not be necessary in this group. In-flight portable oxygen may need to be used while in the lavatory, thus space for the container is usually required on the floor. Within the lavatory, all door and faucet handles should be lever operated.

## GROUP 2 - Unaided Walker with Altered Toileting Ability

Frail and Elderly

Obesity

Stroke

Head Injury

Renal Failure

Multiple Sclerosis

Spinal Cord Injury - Cauda Equina/Incomplete Injury

### Access to Lavatory / Functional Use

This group may be able to walk short distances to the lavatory but may have significantly altered toileting management compared to Group 1, and will need more special attention and assistance. The seating selection needs to be near the lavatory. They may be able to walk down the aisle and enter the lavatory but may have less control of body movement, and be more likely to have shortness of breath on exertion and be at risk for falling. Body strength may be very limited in the legs or only partial on one side. Sensation throughout the limbs is partial or decreased thus making foot placement difficult. This group is prone to skin breakdown on bony prominences.

balance. They are usually unable to lift and carry objects because their hands are managing the walking device.

#### Access down the aisle of the aircraft

In most cases, the people in this group will use the walking aid for boarding and to proceed down the aisle. They will then need assistance to store the aid before they make it down the aisle using seats backs for support. Pivoting at the seat and sitting down may be difficult and is often where another person needs to assist in lowering the weight of the person with a disability slowly into the seat. The armrests of the seat will be used for hand hold support and in place of a grab bar. Personal assistance may also be needed in getting out of the seat, and for negotiating the "gap" between the end of the aisle and the lavatory.

## B. LIMITED AMBULATION WITH AIDS

### GROUP 1 - Assisted Walker with Normal Toileting

Cerebral Palsy

Spastic Diplegia- legs may be weak or have tight muscles, with limited joint range and stiffness

Athetoid - jerky, uncontrolled movement in part or all of the body, can be associated with either weakness or very strong muscles

Hemiplegic - one half or part of the body having either weak or tight muscles with near normal function on the other half of the body

Amputation

Poliomyelitis

Muscular Dystrophy

Arthritis

Orthopedic Problems

Cardiac

Epilepsy

Congenital defect

### Access to Lavatory / Functional Use

The spatial requirements for thresholds and pivot turns of 90-180 degrees are the same as the unaided group, however the toileting needs are normal. Bladder and bowel management in this grouping is usually volitional and well timed with opportunity. They may prefer to use the airport lavatory prior to boarding due to the extra space and time needed for toileting. This will not preclude their use of the aircraft lavatory. Depending upon flight duration, these persons with a disability will need to use the aircraft lavatory and the extra time requirements will need to be considered. Pads and leg bag collection devices may be used. Entry into the lavatory with walking aids will require extra space in door width and turn around area. The walking aid will most likely be stored outside the lavatory during

the toilet use. Clothing management may require more assistance due to appliances such as braces, prosthetic and orthotic devices.

## GROUP 2 - Assisted Walker with Altered Toileting

Multiple Sclerosis

Elderly

Obesity

Stroke/Cerebral Vascular Accident

Head Injury

Neuromuscular Diseases

Developmentally Disabled

### Access to Lavatory / Functional Use

Thresholds of one inch or more may be only be managed with difficulty and they may require another person to actually lift the leg over the threshold. The person with a disability may take their walking aid into the lavatory. They will usually be able to take one step forward into the lavatory and do a pivot turn of 90 or 180 degrees if full weight bearing on one leg is possible. Vertical grab bars on both sides of the toilet are required. If available, a raised toilet seat of up to 24 inches from the floor would increase the ease of sitting down and rising. Help for management of clothing and wiping after toileting may be necessary.

### Functional use of Lavatory and Physiology

In this group, the traveler may request seating as close to the lavatory as possible due to problems of frequency and/or urgency of needing to use the restroom. Muscle control of the bladder sphincter may be partial and the person can have problems of incontinence when stressed during physical activity. Management of the bladder may be unregulated and can only will be controlled for short periods of time. Use of pads and/or a leg bag collection device can be used and it may need to be emptied on 2-4 hour intervals, depending on fluid intake.

Bowel evacuation for persons in this category can be unregulated, however they usually manage a daily bowel program which can be planned around travel periods. These programs are medically developed with the assistance from a person trained in assistance.

When people in this category must get to the lavatory they may need assistance to come to a standing position using either their ambulation aid or lifting help of another person. These people will only walk short distances over smooth surfaces.

### GROUP 3 - Marginal Walker - with Medical Complications

Cancer

AIDS- Acquired Immune Deficiency Syndrome

Spinal Cord Injury - Incomplete Paraplegia

#### Functional Use of Lavatory and Physiology

The same functional use as described in groups 1 and 2 apply to this grouping with the inclusion of more critical medical considerations. Bladder and bowel management may have been surgically altered with the use of special collection bags attached to the lower abdomen. Colostomy and ileostomy bags contain excreted materials and have to be emptied every 2-4 hours. These may produce contaminated material that needs to be isolated from the public. Consideration for privacy and odor containment is essential. Special plastic disposable bags with a lock closure may have to be supplied, with after use storage designated in the lavatory. The lavatory may be also be used in cases of nausea and vomiting. Particular safety issues need to be addressed to prevent bruising and bleeding by accidental injury incurred during the use of the lavatory by this group of persons with a disability who use ambulatory aids. This group is particularly sensitive to pressure on bony areas of the buttocks and limbs.



## C. WHEELED MOBILITY

### GENERAL DESCRIPTION

In this category, the traveler with a disability has no functional walking ability and depends upon the use of some sort of wheelchair for all mobility. Depending on their level of upper extremity function they could further be categorized as those capable of independent transfer, those who are partially dependent and require assistance to transfer and those who are completely dependent in transfers. Usually this traveler will make prior arrangements with the airline in planning for their particular needs which will include access to the gate or jetway, entering the aircraft with a boarding chair and specific seating assignment to meet their needs during the flight. Any mobility within aircraft in-flight will require some assistance of another person to at least retrieve the in-flight wheelchair.

Some travelers will be alone, needing only access to the in-flight wheelchair and perhaps some assistance negotiating to the lavatory. These persons are usually well versed in coping with their environment and will be able to direct anyone on how best to assist them in all aspects of mobility. Others in this category may have a severe disability and may travel with a person trained to meet all their needs except for the unusual demands of access on board the airline.

### Functional Limitations of Persons Independent in Transfers

The most assistance needed would be retrieving of the in-flight wheelchair and positioning it for the person with a disability who would independently transfer into it. These people may need to be pushed down the aisle towards the lavatory depending on their upper extremity strength and the hand hold available at exits and galleys. Proper positioning of the in-flight wheelchair will enable the traveler with a disability to transfer safely. Seating choice is critical for positioning the in-flight wheelchair next to an aircraft seat. A flip up or movable aircraft seat armrest will enable the individual to transfer more easily.

This group is not able to stand and bear weight on their legs, and is unable to pivot balancing on legs, or take steps. They are usually unable to easily manage thresholds of any height using the in-flight wheelchair without the help of another person lifting their weight in a tilt back of the wheelchair. The upper extremities are used to support all the body weight when changing positions and balancing as back support is removed.

Transfers for this group are described as a method to lift the body out of one seat and into another, or the change of position in preparation for minimal assisted movement in a lateral plane. Most persons in this group can perform independent transfers and will need assistance only for propelling the in-flight wheelchair. To accomplish an independent transfer, the wheelchair is positioned next to the seat or toilet, locked in place and the armrests raised in the up position. The person with a disability then leans forward and places a hand on the alternate armrest and lifts 100% of their weight using the arms to move in the lateral plane to the other surface. Others in this category may need minimal assistance in transfers, such as a simple boosted lift under the buttocks to accommodate the difference in seating heights.

#### Functional Limitations of Persons Partially Independent in Transfers

If the person with a disability can lift at least 60-90% of their body weight then the assistance of one person can make the transfer work by a lift or boost. Often when a person with a disability does a lift they may not be able to actually move laterally and a light tug in the direction of the transfer is sufficient.

Depending upon the diagnosis and degree of disability, these persons will have limited endurance, severe weakness, and lack the normal sensation of touch, pressure and temperature in some parts or all of the body. Some persons will use special cushions under the buttocks to prevent pressure sores and to protect the bony areas. Assistance may be needed to transfer the special cushion from the aircraft seats. They are at risk for medical complications if exposed to extreme heat or cold for periods of time due to poor body temperature regulation. Muscle strength may be flaccid with no movement, rigid, or jerky and uncontrolled. Limited strength may be accompanied by balance deficits, limited control to maintain head upright, and the need for restraints for the chest, lap and head

supports to remain sitting upright. Minimal use of hands for dexterity will alter the persons ability to hold on grab bars for support and to operate handles and switches. The person with a disability may have limitations in joint range and medical restrictions in flexibility, often making sitting in an upright position not tolerated.

### Functional Limitations of Persons Dependent in Transfers

This group requires the greatest assistance for in-flight wheelchair positioning and transfers.

The physical management of moving out of their seat, into the in-flight wheelchair and accessing the lavatory requires the physical assistance of 1 or 2 persons helping. This may be accomplished with a modified fireman's carry lift and executed by a trained person who accompanies the disabled traveler.

A dependent transfer is difficult to execute due to the required space needed for another person in a biomechanically correct squatting position.

This group of persons may use the same transfer method within the lavatory. Full assistance will be needed for the management of clothing and may be needed for toileting. Extra time will be needed to do the transfer and toileting. Privacy is critical to maintain the dignity of the person with a disability who will have to direct another person in their care.

## C. WHEELED MOBILITY

### GROUP 1- Independent Transfers with Normal Toileting

Cerebral Palsy

Muscular Dystrophy

Poliomyelitis

Orthopedic

Arthritis

Amputation

Brain Injury

Adult Respiratory Distress Syndrome

\* Does not include Spinal Cord Injured Paraplegia

This group usually has volitional control of their bladder and bowel on a timed basis, and in most cases are able to control their need to use the toilet every 4-6 hours. For convenience and to avoid having to transfer from the wheelchair to the aircraft lavatory toilet, the person with a disability may choose to use the lavatory in the terminal before boarding the plane. This does not preclude their need to use the lavatory on the aircraft.

### Access Down The Aisle

When these passengers need to use the lavatory on the airplane, the in-flight wheelchair will have to be positioned next to the seat, locked, and angled to permit space for the transfer. The in-flight wheelchair will need to have a flip up or movable armrest, so that the person does not have to lift the buttocks up and over the armrest. In the most common method of transfer, the person will lift their buttocks up first, and move to the wheelchair. The legs and feet will then be placed onto the footrests. Care should be taken to prevent any accidental loss of balance once in the wheelchair and the chest and seatbelts should be secured.

Once in the in-flight wheelchair, another person will have to push the weight of the person towards the lavatory avoiding any unnecessary turns which could alter the balance and position of the person with a disability. The aisle width, hip size

and shoulder girth will dictate if the person can be pushed to the lavatory. Adequate space to do the turns will require that the exit or galley area be used. If the wheelchair is positioned inside the lavatory the person will have to have adequate space to reach down to remove their feet off the footrest. The assisting person will have to lock the brakes from the back of the in-flight wheelchair.

### Functional Use of Lavatory and Physiology

This group of persons may require help in management of their clothing and with wiping after toileting. If another person is to assist, space for that person to get into the lavatory will need to be considered. The normal amount of time to do toileting can be assumed if the transfer is easily negotiated. If the person with a disability is non-speaking, they may use a communication device.

### GROUP 2 - Partially Independent in Transfers with Altered Toileting\*

Multiple Sclerosis

Neuromuscular Disease

Stroke/Cerebral Vascular Accident

Head Injury

Congenital Disability

\* Does not include Spinal Cord Injured Quadriplegia

### Access to Lavatory

This group will need assistance in transfers out of the seat to the in-flight wheelchair. They will need help down the aisle and in the lavatory. The access and position of the wheelchair will now need to accommodate another person to assist in the transfers. Persons in this group will be unable to lift more than 60-80% of their weight and will need another person to stand at their knees and lift the hips and legs into position during transfers.

### Functional Use of Lavatory and Physiology

This group may have a neurogenic bowel and/or bladder which operates without volitional control of the sphincter (valve). This group has a greater chance of bladder and bowel accidents if not well controlled with a specific method of daily management. (This group does not include Spinal Cord Injured persons who use a regimented program for bladder and bowel control.) These people may use toileting accommodations such as pads, catheters with leg bag appliances or ileostomy bags to collect urine and/or feces. This equipment usually meets the evacuation needs of a person for a 4-6 hour interval. This interval is also influenced by the person's food and liquid intake prior to and during the flight. Emptying or servicing these collection systems can require the assistance of another person. A portable urinal can be used to drain the leg bag from the valve near the ankle.

A well managed neurogenic bowel functions on a twenty-four to forty-eight hour basis. This is a controlled program that is used to prevent incontinence. The bowel program is usually well timed with travel. The bowel program is a major undertaking and will likely involve another person, taking up to thirty to sixty minutes. Assistance will be needed for wiping and dressing.

### GROUP 3 - Dependent in Transfers with Normal Toileting

Cerebral Palsy

Muscular Dystrophy

Polio Myelitis

Orthopedic

Arthritis

Amputation

This group will have volitional control of their bladder and bowel on a timed basis and in most cases are able to control their need to use the toilet every 4-6 hours. For this group, the physical management of moving out of their seat, into the in

flight wheelchair and access to the lavatory requires physical assistance with 1 to 2 persons helping.

#### Access Down the Aisle

This group may need assistance in the transfer out of the aircraft seat into the in-flight wheelchair. This group may not have sufficient strength to help in transfers and will have to be lifted by 1 person, facing the individual. The assistant will have to negotiate the wheelchair down the aisle and position next to the lavatory to repeat the transfer onto the toilet.

#### Functional Use

All management of clothing and wiping after toileting will be done with assistance. The normal amount of time to do toileting can be assumed if the transfers are easily negotiated.

#### GROUP 4 - Dependent In Transfers with Altered Toileting

Persons with Severe Disabilities and multiple medical problems including Ventilator Dependent Spinal Cord Quadriplegics

#### Access to Lavatory

In this group, the person with a disability is completely dependent in transfers and does not have the capacity to push up and lift any body weight, and generally, one person is necessary to assist. This method of transfer is accomplished by another person facing the person with a disability and lifting the buttocks and the legs together from under the knees.

Transfer of this group can be accomplished by one very skilled person who can execute a modified fireman's carry lift. This method of transfer is not recommended unless the trained person is well versed in body mechanics and prevention of injury to the person with a disability as well as themselves.

Ventilator Dependent Quadriplegia - These persons have complete paralysis in arms and legs, unable to breathe without ventilation equipment. They need two persons for transfers, and require good support for head, neck, and trunk.

This group of persons with a severe disability will travel only with one or two persons who are trained in their care. They will have a management program for their neurogenic bladder and bowel and have special collection bags for toilet needs. Once the person with a disability is safely transferred into the aircraft seat with the ventilator stored next to them, they will not be likely to use the lavatory. To do so would be extremely difficult and precarious. The skilled person will use a portable urinal to empty the leg bag, and may have to use portable suctioning equipment to deal with oral and respiratory secretions. This group of persons with a disability may use a feeding tube. The skilled person will use the lavatory for cleaning of the equipment or appliances.

If upright sitting may not be feasible, this person will need to make arrangements for travel on a stretcher. If for any reason the ventilator is non-functioning, another person would use a manual "bagging" method to assist the person in respiration.

#### GROUP 5 - Spinal Cord Injured with Altered Toileting

Paraplegia- A person's legs are paralyzed and they have good use of arms and hands. There may be some limited trunk balance.



### Functional Use of Lavatory and Physiology

This group of persons with a disability will most likely be independent in transfers and can use the in-flight wheelchair with very little assistance once the chair is made available. They will manage their bladder function either by voiding on the toilet or use of leg bag collection devices. If use of a portable urinal is not acceptable for emptying a leg bag, then this group will access the lavatory and place one leg up onto the toilet seat and drain the bag into the toilet without the need to transfer onto the toilet.

Some persons will do an intermittent catheterization technique where they place a sterile catheter into the bladder on a temporary basis every four to six hours. These people will either transfer to the toilet or do the catheterization while in the in-flight wheelchair, using a portable urinal in the privacy of the lavatory. Emptying a leg bag into the toilet would be most easily accomplished in a lavatory that accommodates that in-flight wheelchair positioned close to the toilet.

These people will manage their bowels with a timed program and it is unlikely they will need to evacuate their bowels during a flight. The lavatory will need a door width to accommodate the in-flight wheelchair, and grab bars on one side of the toilet seat will be needed for the transfer. These people have reduced or no sensation in their legs of buttocks and they are susceptible to bruising and pressure on the skin and muscle. Minimal accidents occur with this group and most will be able to manage their clothing and wiping after toileting.

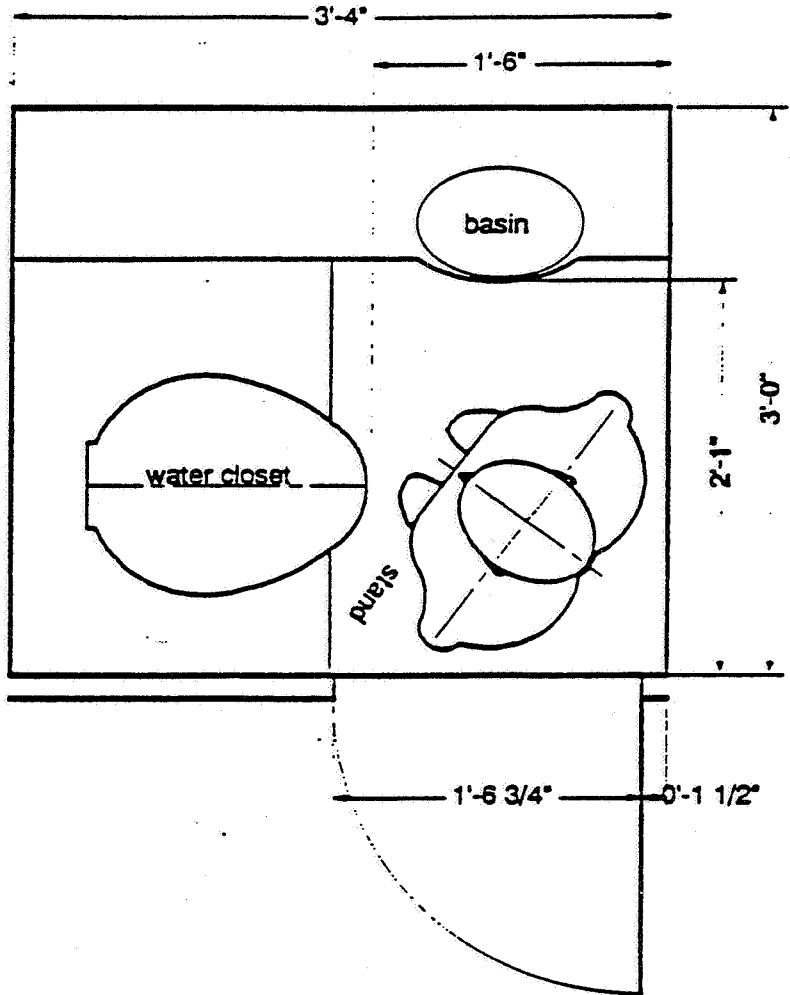
Quadriplegia- A person has a degree of paralysis in arms and hands and full paralysis in legs. They have limited trunk balance and require trunk support during seating and transfers. Some will need support for the neck and shoulders.

### Functional Use of Lavatory and Physiology

This group requires one or two persons assisting in transfers, management of their neurogenic bladder and bowel management, dressing and hygiene. They may do intermittent catheterization, or leg bag draining while seated in the in-flight wheelchair. They may have occasional need for bowel management if problems

occur with timing or accidents. This group has greater probability of having severe medical complications if the bowels and bladder are not well managed. Autonomic Dysreflexia is one such complication which requires immediate attention. One symptom of Autonomic Dysreflexia is a rise in blood pressure. Management of the bowel and bladder requires emergency care to decrease the rise in blood pressure. In order to perform any lavatory activities there will be spatial requirements for the person in the in-flight wheelchair and transfer room for a person assisting in squatting position. This group of travelers may travel with a person familiar with their care.

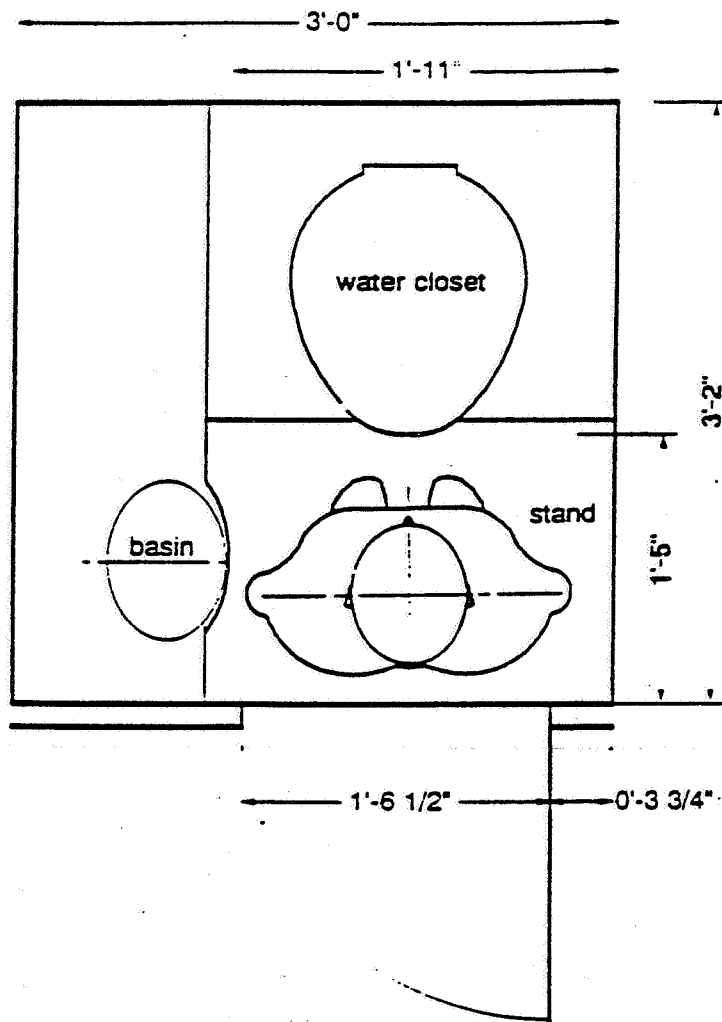
APPENDIX B



A. Limited Ambulation - Unaided walker

This shows the spatial requirements of a 97.5% male to enter the lavatory.

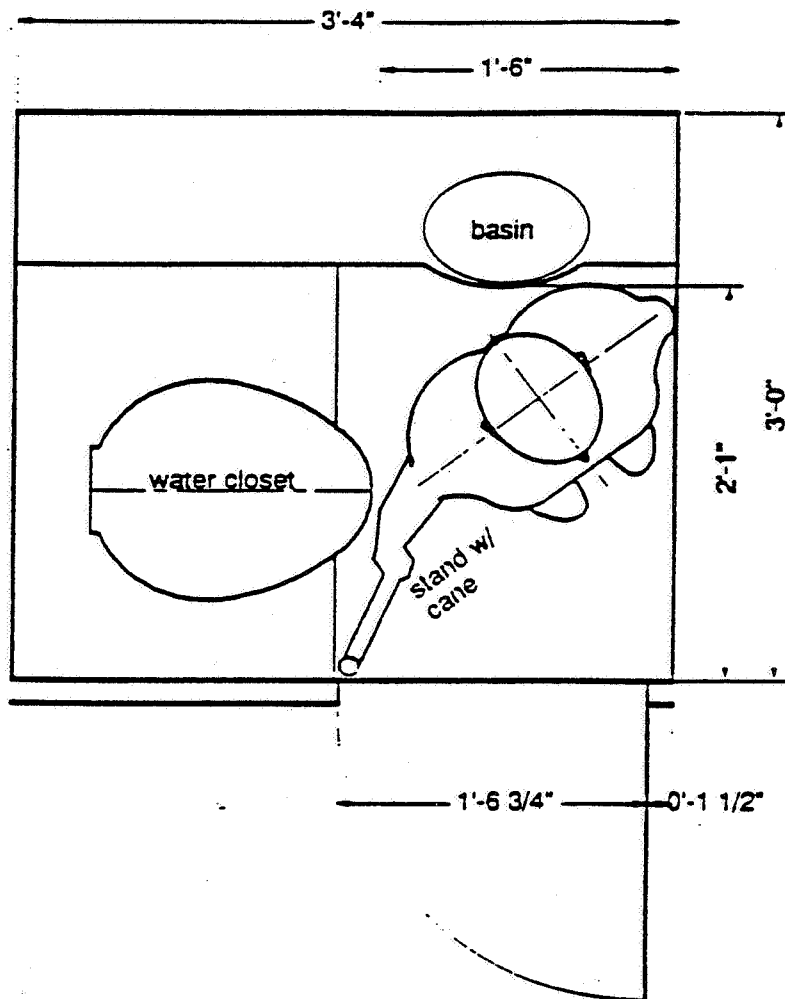
90° LAVATORY SCALE: 1" = 1'-0"



A. Limited Ambulation - Unaided walker

This shows the spatial requirements of a 97.5% male to enter the lavatory.

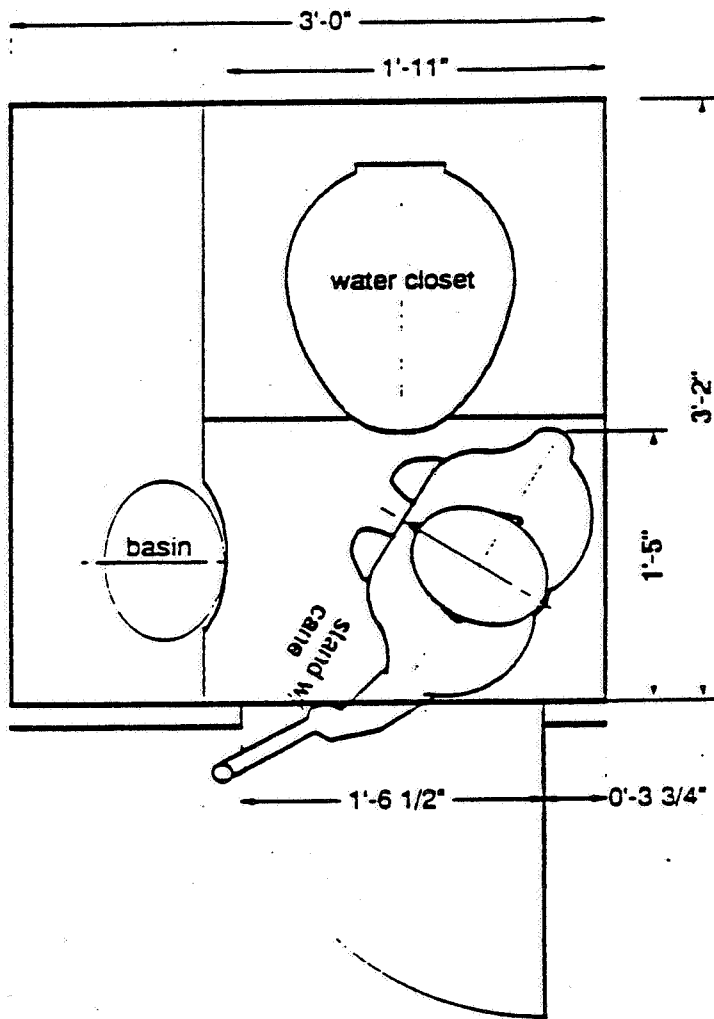
180° LAVATORY SCALE: 1" = 1'-0"



**B. Limited Ambulation - With aids for walking**

This shows the spatial requirements of a 97.5% male entering the lavatory with a crutch on one side. The crutch will be put aside once in the lavatory and the person will use the hand holds within the lavatory space for support. The person will be able to pivot to do a 90-180 degree turn.

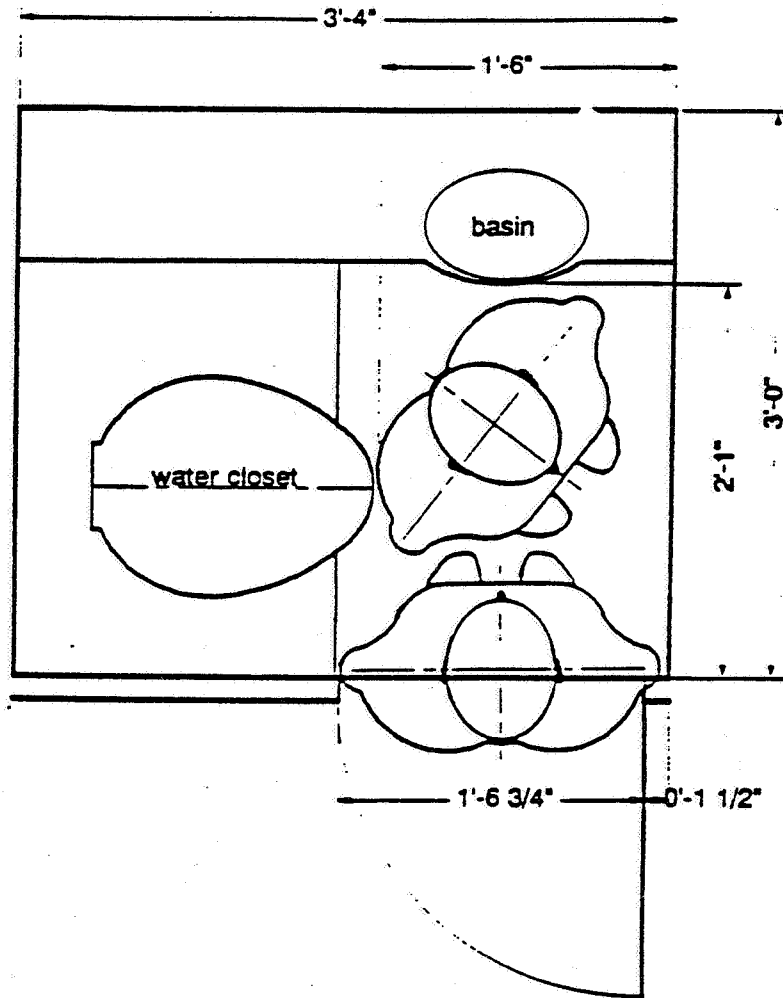
**90° LAVATORY** SCALE: 1" = 1'-0"



**B. Limited Ambulation - With aids for walking**

This shows the spatial requirements of a 97.5% male entering the lavatory with a crutch on one side. The crutch will be put aside once in the lavatory and the person will use the hand holds within the lavatory space for support. The person will be able to pivot to do a 90-180-degree turn.

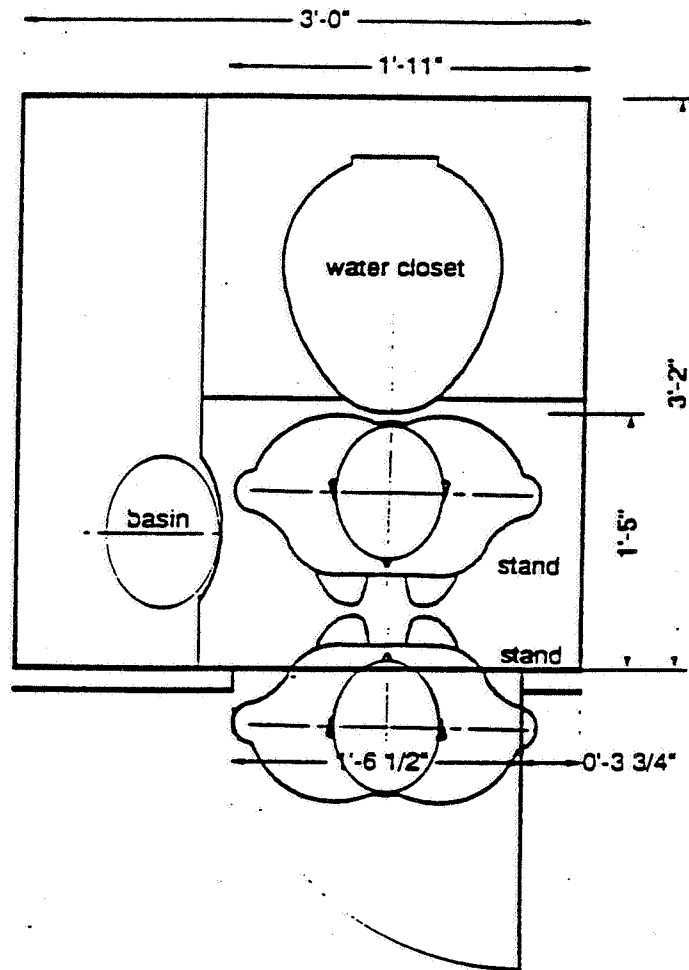
**180° LAVATORY** SCALE: 1" = 1'-0"



**B. Limited Ambulation - With aids for walking - 1 person assisting**

This shows the spatial requirements of a 97.5% male aided walker (cane or crutch set aside) using the lavatory and coming to stand with the assistance of 1 person (97.5% male). This represents the space needed for help in management of hygiene and clothing by the assisting person.

**90° LAVATORY** SCALE: 1" = 1'-0"



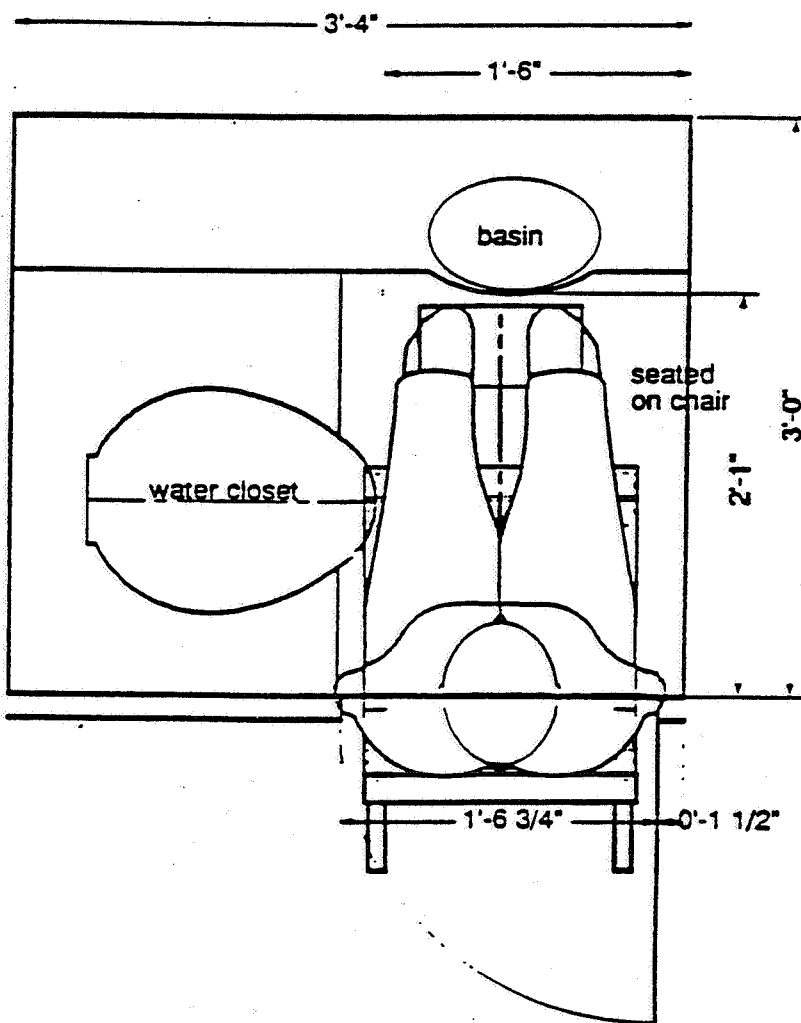
Keep/Toss  
 Return

**B. Limited Ambulation - With aids for walking - 1 person assisting**

This shows the spatial requirements of a 97.5% male aided walker (cane or crutch set aside) using the lavatory and coming to stand with the assistance of 1 person (97.5% male). This represents the space needed for help in management of hygiene and clothing by the assisting person.

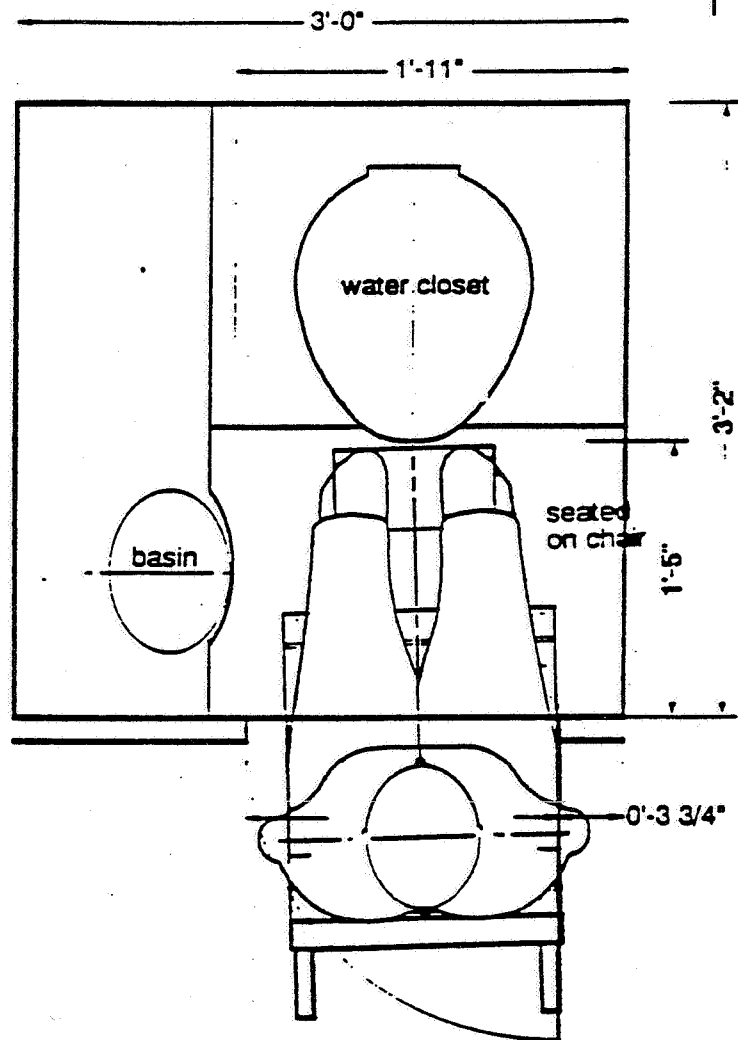
**180° LAVATORY** SCALE: 1" = 1'-0"  
 56





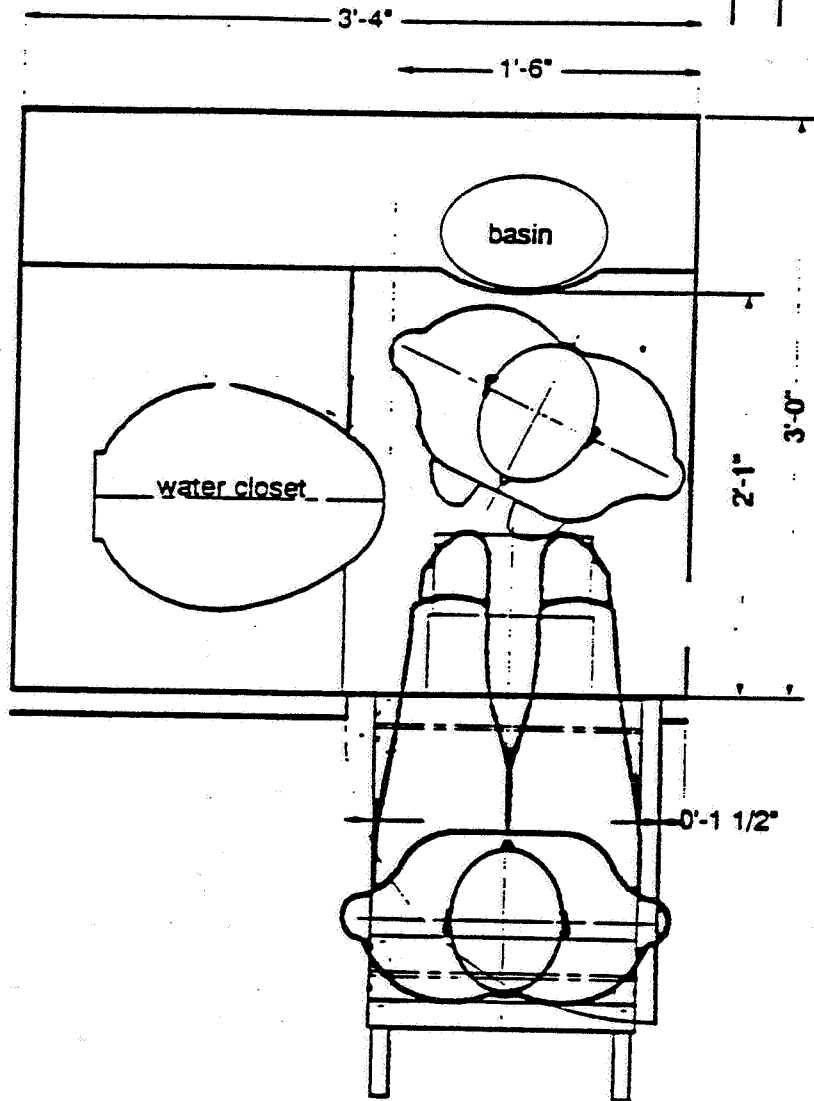
C. Wheeled mobility - Independent transfer

This shows the spatial requirements of a 97.5% male in the in-flight wheelchair entering the lavatory. This position is also representative of the space needed for the person to lift a leg up to the toilet for emptying a leg bag.



**C. Wheeled Mobility - Independent transfer**

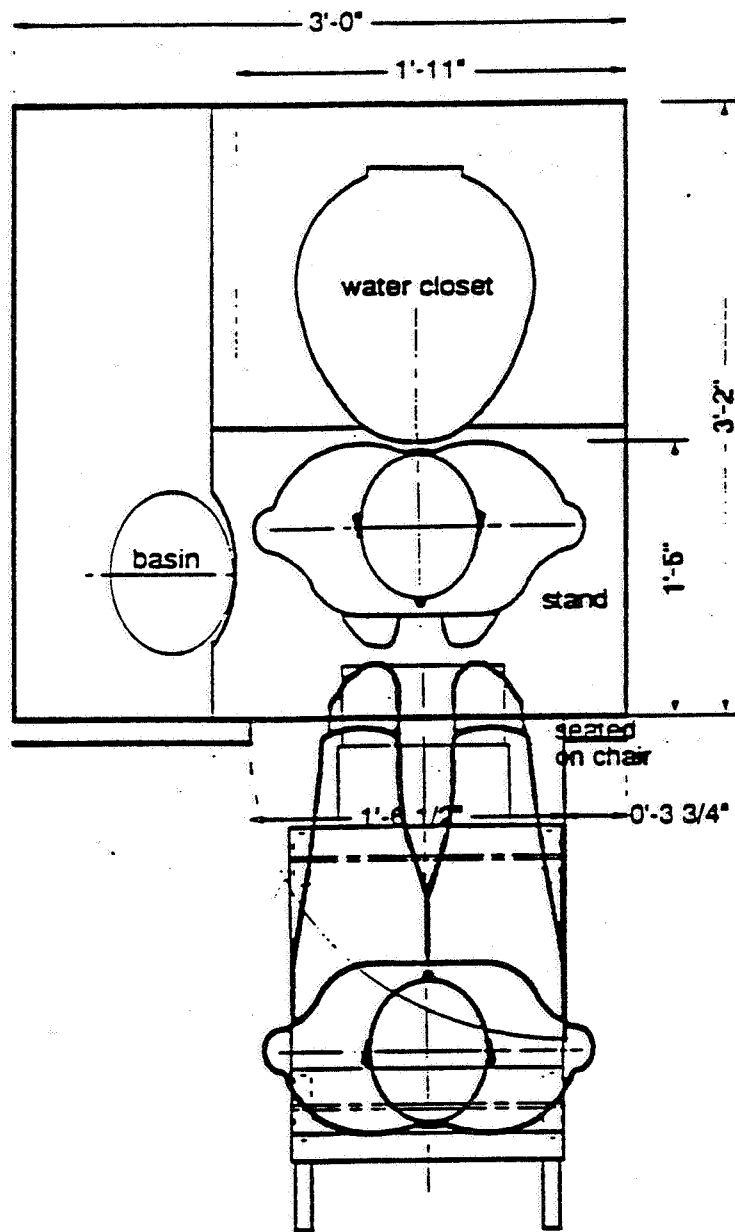
This shows the spatial requirements of a 97.5% male in the in-flight wheelchair entering the lavatory. This position is also representative of the space needed for the person to lift a leg up to the toilet for emptying a leg bag.



**C. Wheeled Mobility - 1 person assisting in transfer**

This shows the spatial requirements of a 97.5% male in the wheeled mobility group who uses the in-flight wheelchair and 1 person assisting in the transfer to the lavatory. This position of the assistant may be used to assist in emptying leg bags.

**90° LAVATORY** SCALE: 1" = 1'-0"



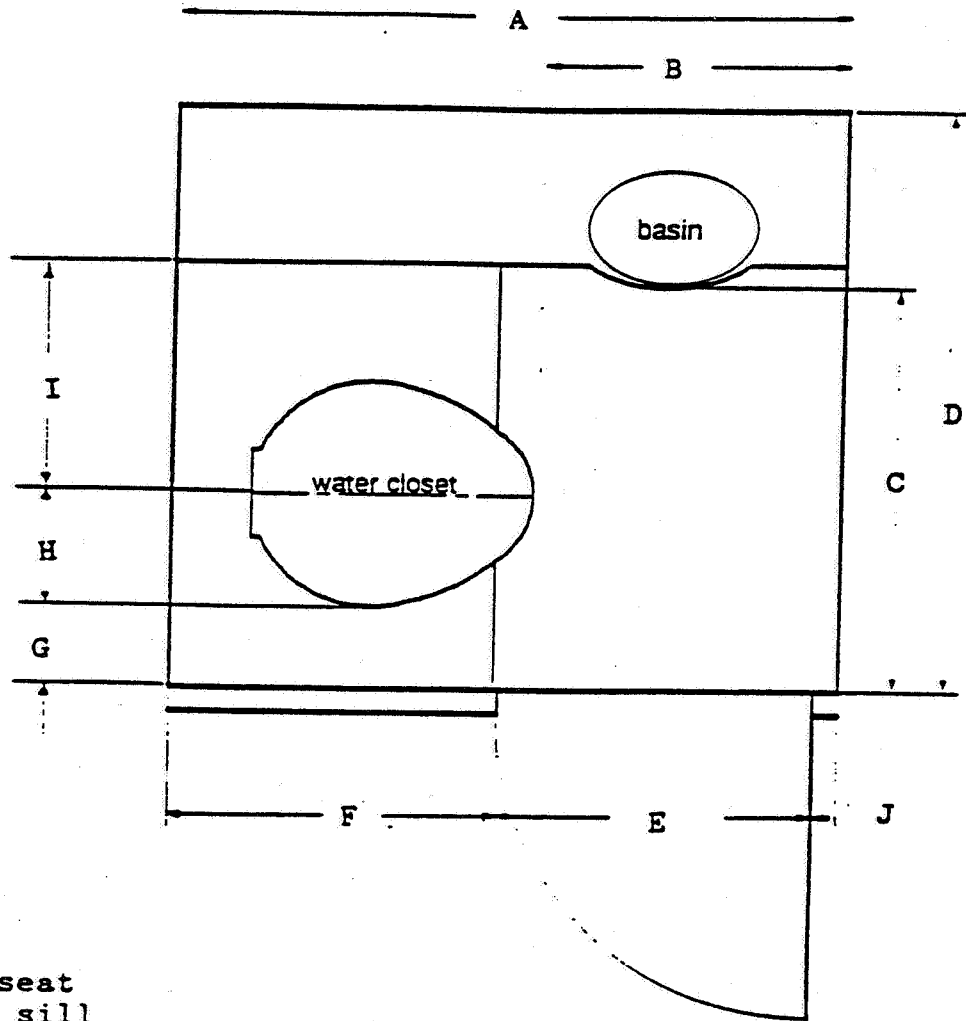
**C. Wheeled Mobility - 1 person assisting in transfer**

This shows the spatial requirements of a 97.5% male in the wheeled mobility group who uses the in-flight wheelchair and 1 person assisting in the transfer to the lavatory. The position of the assistant may be used to assist in emptying leg bags.

**180° LAVATORY** SCALE: 1" = 1'-0"

# 90° LAVATORY SCALE: 1" = 1'-0"

## LAVATORY CONFIGURATION DATA



provide  
 dimensions of:

lavatory seat  
 at door sill

D. Gerald Warren & Assoc. Operational Measurements	AIRCRAFT TYPE		
	737-300	757-222	737-300
46	33	28	?
27	19	18	17.5
29	19	?	?
48	32	28	?
20	19	18.5	18
20	27	?	?
8	14	?	?
7.5	5.5	?	?

## REFERENCES AND ACKNOWLEDGEMENTS

Anthropometric data taken from Human Scale.

1/2/3 The MIT Press, Cambridge, MA.

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Thanks to the persons with disabilities who assisted in the study.

**FINAL DRAFT**

**July 5, 1991**  
**(Revising May 16 draft)**

**APPENDIX C**

**SIGNS AND AUDIBLE WARNINGS**

**(To Be Developed)**

**FINAL DRAFT**